BLH 1200B

OPERATING & SERVICE MANUAL

MP MASTER

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OPERATING AND SERVICE MANUAL

1200B
PORTABLE DIGITAL
STRAIN INDICATOR

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Figure 1-1. Model 1200B Portable Digital Strain Indicator

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. General.

1-3. The BLH Model 1200B Portable Digital Strain Indicator, Figure 1-1, is designed to amplify, measure and display the millivolt per volt output of wire and foil strain gages in microinches per inch.

1-4. Basic Functions.

1-5. The instrument generates a regulated bridge excitation voltage of approximately 4.8V and will accommodate a 1/4, 1/2 or full bridge configuration. Gages with resistances of 120Ω or 350Ω (1/4 bridge configurations) and from 60 to 2,000Ω (1/2 and full bridge configurations) can be used with the instrument. Gage factor range is from 0.500 to 9.500. Readout is instantaneous and is displayed in four digits on light emitting diodes (LED's). An automatic non-blinking polarity indicator is located to the left of the most significant digit. Drift caused by ambient temperature variations is automatically eliminated with an integral auto-zero circuit.

1-6. Supplementary Capability.

1-7. Although designed primarily for use with wire and foil strain gages, the instrument can also be used to measure the mV/V output of a single wire or foil strain gage transducer.

1-8. DESCRIPTION.

1-9. The Model 1200B is completely self-contained in a vinyl-covered case whose dimensions are 25.08 X 18.58 X 36.20 cm. (9-7/8 X 7-5/16 X 14-1/4 in.). It weighs approximately 5.44Kgs (12 lbs). Solid-state modular IC construction has been used throughout. The modular concept simplifies troubleshooting and maintenance, and insures trouble-free operation.

1-10. There are two basic versions of this instrument. One is ac powered and the other is battery powered. The ac-operated instrument is designed primarily for laboratory use. The battery-operated instrument is suitable for either short-run laboratory testing or field use. Both power versions can be supplied with a single instrument.

1-11. Options and Accessories.

1-12. The following options are available with the Model 1200B:

Option 01. Model 1200B with 115/230Vac Power Supply.
Option 01A. Model 1200B with 100/200Vac Power Supply.
Option 02. Model 1200B with rechargeable battery pack (115/230Vac recharging circuit).
Option 02A. Model 1200B with rechargeable battery pack (100/200Vac recharging circuit).
Option 03. Model 1200B with BCD output.
Option 04. Model 1200B prepared for instrument rack mounting.
Option 05. Model 1200B with peak and hold circuit.

1-13. The BCD output option enables the Model 1200B readouts to be transmitted to external devices such as printers, computers, data acquisition systems, etc. The BCD output is made available via a connector on the rear panel of the instrument.

1-14. The peak and hold option is used to hold and display the highest level reached on a varying input signal. Typical applications include the measurement of instantaneous shock loading and the recording of pressure surge levels. Analog aperture time is 100 milliseconds. Hold time is 5 minutes to 0.10% or 1mV/minute.

1-15. Options 01 through 05 are all available with a single instrument. However, option 05 (peak and hold circuit) is not operable with option 02 (or 02A) (rechargeable battery power power supply). It can only operate with option 01 (or 01A) (ac power supply). For instruments sold with both options - 01 and 02 - instructions for switching from one type of power supply to the other are provided in Section II.

1-16. An extender board useful for troubleshooting and checking the power supplies is available as an accessory. The BLH Model 625 Precision Calibrator is an essential instrument for calibration and troubleshooting of the Model 1200B.

1-17. Controls.

All controls are functionally grouped on the front panel of the instrument. A grouping of three pushbuttons allows the instrument to be accurately set for the correct bridge configuration in use. Initial gage bridge imbalance is cancelled with the COARSE- and FINE BRIDGE BALANCE controls. The approximate gage factor of the

gage in use is set into the instrument with the COARSE GAGE FACTOR switch. Exact gage factor setting is dialled in with the FINE GAGE FACTOR controland is displayed by the digital readout when the GF ADJ pushbutton is depressed. Gages are connected to color-coded three-way terminal posts.

1-18. Two pushbutton switches are provided to check the optional battery pack. Level of charge is indicated on the digital display. A reading below 4100 when either battery check switch is pressed indicates that the batteries should be recharged. A DISPLAY and a READ switch control the digital display readouts. A DISPLAY TIME switch controls prime power turn-on and also sets up the length of momentary readouts for conservation of power with battery operated instruments. A dynamic output oscilloscope jack, along with an analog output selector switch enables the monitoring of either filtered or unfiltered analog strain signals by either oscilloscope or analog recording device. A POWER indicator light completes the front panel controls. A rear panel selector switch enables the selection of either 115-volt or 230-volt (or 100-volt or 200-volt) ac operation.

1-19. SPECIFICATIONS.

1-20 The Model 1200B specifications are listed in Table 1-1.

Table 1-1. Specifications

INPUT	
Bridge Configuration:	120Ω and 350Ω quarter bridge; 60Ω to 2000Ω half bridge or full bridge.
DISPLAY CHARACTERISTICS	
Readout:	7-segment display, 11mm (0.43") light emitting diodes (LED's).
Polarity:	Automatic plus or minus polarity indicators.
PERFORMANCE	
Sample Rate:	2 readings per second.
Auto Zero:	Automatic electronic zero is employed.
Short-time reading stability:	±2 counts.
Linearity:	±0.04% of reading; ±1 digit (full bridge, 4 active gages).
OUTPUT:	
Low Range (X1):	0 to ±10,000 microinches per inch (1 microinch per inch resolution). Overranges to ±19,999 microinches per inch for Gage Factor settings of 0.500 to 5.000. Decreases linearly from maximum of ±10,000 microinches per inch for Gage Factor settings of 5.000 to 10.000.
High Range (X10):	0 to ±100,000 microinches per inch (10 microinches per inch resolution). Overranges to ±199,990 microinches per inch for Gage Factor setting of 0.500 to 5.000. Decreases linearly from maximum to ±100,000 microinches per inch for Gage Factor settings of 5.000 to 10.000.
DYNAMIC OUTPUT	
Range:	Approximately ±1.000 volt out for ±10,000 microinches per inch with a Gage Factor of 2.000 at a bridge excitation voltage of 5.0 volts. Dynamic output is independent of instrument Gage Factor setting and proportional the negative battery voltage when operated with the battery pack. Maximum dynamic output is ±5 volts at 1 milliampere. Recommended for use with ac power supply only.
Impedance:	Less than 10Ω.
Frequency Response:	Flat ±10% to 50KHz (to 5Hz with filter).

Table 1-1. Specifications (Continued)

Slew Rate:	Approximately 300mV/μsec.
Noise:	10mV peak-to-peak with ac power supply.
Auto Zero:	Inserting an instrument jack for dynamic output disconnects the auto zero circuit in the preamplifier when ANALOG OUTPUT switch is in 50KHz position.
BCD OUTPUT (Option 03)	
Format:	Four BCD digits (1-2-4-8) plus single bit polarity.
Logic Levels and Currents: (Standard TTL)	Logic "1" = 2.4V min. Logic "0" = 0.4V max. All digital output signals are capable of sinking 8mA at lower logic level and sourcing 0.2mA at upper logic level.
Data Ready Signal:	Upper level (+2.4V min.) to lower level (+0.2V max.) transition with output returned to upper level exponentially in 12μsec (nom.).
CONTROLS	
Gage Factor Adjustment:	Coarse ten-position switch plus ten-turn potentiometer for fine adjustment. Total gage factor range: 0.500 to 9.500 with resolution of 0.001. The GF setting is displayed on the digital readout when the Gage Factor pushbutton is depressed.
Bridge Balance - Static Mode:	±5,000 microinches per inch at Gage Factor of 2 for 1/4 and 1/2 bridge positions on both X1 and X10 positions. For full bridge setting; ±5,000 microinches per inch in X1 position and ±50,000 microinches per inch in X10 position. Adjustment is an integral part of the amplifier circuit and therefore does not load the output of the bridge.
Bridge Balance - Dynamic Mode:	±5,000 microinches per inch at Gage Factor of 2 for 1/4 or 1/2 bridge or 120Ω or 350Ω full bridge. Adjustment is a standard "T" network on bridge output. Range is inversely proportional to Gage Factor setting.
Battery Check:	Two pushbuttons are provided to check the batteries. The actual charge state on the batteries is indicated on the digital display. A reading below ±4100 indicates that the batteries should be recharged.
TEMPERATURE	
Range:	0-55°C (32-130°F).
Effect on Zero:	±0.01%/°C (±0.005%/°F) of span range.
Effect on Span:	±0.01%/°C (±0.005%/°F) of span range.
POWER	
Power Requirements:	115/230Vac ± 10% (or 100/200Vac ± 10%), 50 to 400Hz, or internal rechargeable battery pack. To order, specify Part No. 43310 for Model 1200B without power source. For 115/230Vac power source, order option 01, Part No. 433647. For 100/200Vac power source, order option 01A, Part No. 433653. For batteries with 115/230Vac rechargeable power supply, order option 02, Part No. 416176. For batteries with 100/200Vac rechargeable power supply, order option 02A, Part No. 433655.

Table 1-1. Specifications (Continued)

	The ac power supplies and the rechargeable battery packs are modular units and are interchangeable.
Battery Pack:	Eight 1.2V rechargeable nickel cadmium batteries. Four batteries form a +4.8V supply for the digital logic and four batteries form a -4.8V supply for bridge excitation power.
	a dc-to-dc converter operating from the ±4.8V supplies produces ±12V for operation of the analog circuits.
Battery Life:	One hour continuous duty. Considerably longer when using self-contained battery saver circuit. Batteries can be charged in excess of 200 times.
Battery Saver Circuit:	Bridge power is turned on by the switch of the DISPLAY TIME control. All other power remains off until the DISPLAY switch is set to ON and the READ switch is either set to ON or momentarily set to the spring-loaded MOM position. As long as the READ switch is in the ON position, display power is turned on. When the READ switch is momentarily set to the MOM position, display power remains on for a period of time which can vary from approximately 2 seconds to 15 seconds depending on the setting of the DISPLAY TIME control.
PHYSICAL	
Size:	25.1 cm W X 18.6 cm H X 36.2 cm D. (9-7/8" W X 7-5/16" H X 14-1/4"D).
Weight:	4.31 kgs (9.5 lbs) for ac version. 4.54 kgs (10.0 lbs) for battery version.

SECTION II
INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains information on unpacking, inspection, repacking, and installation.

2-3. INITIAL INSPECTION.

2-4. Mechanical Inspection.

2-5. If external damage to the shipping carton is evident, ask the carrier's agent to be present when the instrument is unpacked. Check the unit for external damage such as broken controls or connectors, and dents or scratches on the panel surface. If damage is found, refer to Paragraph 2-8 for recommended claim procedure and repacking information. If the shipping carton is not damaged, check the cushioning material and note any signs of severe stress as an indication of rough handling in transit. Retain the packaging material for possible future use.

2-6. Electrical Check.

2-7. Check the electrical performance of the instrument as soon as possible after receipt, see Figure 2-11, for recommended calibration checks. This check is a good test procedure for incoming quality control inspection and for an operational check after repairs or adjustments have been made.

2-8. CLAIMS AND REPACKING.

2-9. Claims for Damage.

2-10. If physical damage is evident or if the instrument does not meet specifications when received, notify the carrier and the nearest BLH Sales/Service Office. The Sales/Service Office will arrange for repair or replacement of the unit without waiting for settlement of the claim against the carrier.

2-11. Repacking for Shipment or Storage.

2-12. If the instrument is to be shipped to a BLH Sales /Service Office, or to the factory, attach a tag showing owner, address, instrument model and serial number, and the repair required. The original shipping carton and packaging material may be reusable. The BLH Sales/Service Office will also provide information and recommendations on materials to be used if the original packaging material is not available or not reusable. Materials should include, (1) a double-walled carton (check with a freight carrier for test strength required), (2) heavy paper or sheets of cardboard to protect all instrument surfaces; use extra material around projecting parts of the instrument, (3) at least four inches of tightly packed, shock absorbing material surrounding the instrument. Close the package securely with heavy paper tape.

2-13. INSTALLATION.

2-14. Location.

2-15. The indicator will operate satisfactorily between 0°C and 55°C (+32°F and +130°F) in most environments. For best operation, however, avoid locations where the instrument will be subjected to temperatures above 43°C or below 0°C. The instrument should not be located in areas containing explosive or corrosive vapors or in the vicinity of strong magnetic fields (e.g. large power transmission cables, welding equipment, high voltage transformers).

2-16. Power Cable.

2-17. To protect operating personnel, the National Electrical Manufacturers' Association (NEMA) recommends that the instrument panel and cabinet be grounded. Both the ac and battery operated models of the instrument are equipped with a 10-foot, 3-conductor power cable; the third conductor is the ground conductor, and when the instrument is plugged into an appropriate receptacle, the instrument is grounded. The offset pin on the power cable three-prong connector is the ground connection.

2-18. To preserve the protection feature when operating the instrument from a two-contact outlet, use a three-prong to two-prong adapter, and connect the green lead on the adapter to ground.

2-19. Power Requirements.

2-20. The ac version of the indicator is designed to operate at either 115 (100) or 230 (200) Vac at 50-400Hz. The battery operated version is supplied with eight 1.2 V rechargeable nickel-cadmium batteries. Four of these are used as a digital logic supply. The remaining four, in conjunction with the power supply circuit, apply a regulated excitation voltage to the strain gage bridge.

2-21. LINE VOLTAGE SWITCH. A two-position slide switch located on the rear of the instrument controls input transformer connections. The number visible on the slider of the switch indicates the line voltage for which the primary windings are connected. Check that the designation on the slide switch matches the nominal voltage of the power source before plugging in the instruments; if not, slide the switch to the other position.

2-22. The batteries are checked with the BATTERY CK 1 and CK 2 pushbutton switches on the front panel of the instrument. A reading of 4100 or below in either switch position indicates that the batteries should be recharged.

2-23. The batteries are recharged by plugging the battery pack into a 115 or 230Vac outlet and pressing the BATTERY CHG button. (Check that the 115/230 slide switch at rear of battery pack is positioned correctly.). It is not necessary to remove the battery pack from the instrument when recharging. Recharging time will vary depending upon the level of charge remaining. Eight hours is usually sufficient.

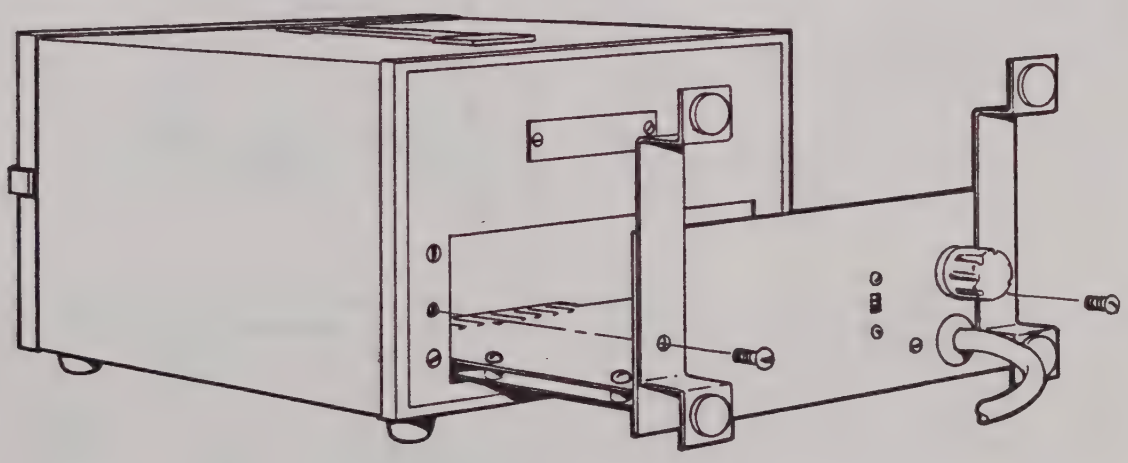
IMPORTANT

The battery pack cannot be recharged during instrument operation. Gage readings taken during recharging will be invalid and should not be attempted.

2-24. Battery life is approximately one hour under continuous service. The battery saver circuit, however, allows considerably longer life. When bridge power is applied to the gages with the DISPLAY TIME switch and the DISPLAY switch is set to ON, all other power remains off. Then the digital display will come on only when the READ switch is set to either ON or MOM. If the READ switch is set to ON, the digital display will remain on as long as the switch remains in that position. If the READ switch is set to MOM (a spring-loaded position) and then released, the digital display will remain on only for the time span set into the battery saver circuit with the DISPLAY TIME control.

2-25. Power Supply Conversion.

2-26. The ac and battery pack power supply modules are interchangeable without modification. Refer to Figure 2-1 for conversion instructions.



(1) Unplug instrument.

(2) Locate and remove the two rear panel power supply retaining screws.

(3) Withdraw power supply by pulling it directly to the rear as shown. If power supply does not move easily, rock it gently from side to side while pulling rearward.

(4) Plug in conversion unit firmly. Make sure edge connector engages in receptacle and secure unit with the two retaining screws.

Figure 2-1. Power Supply Conversion

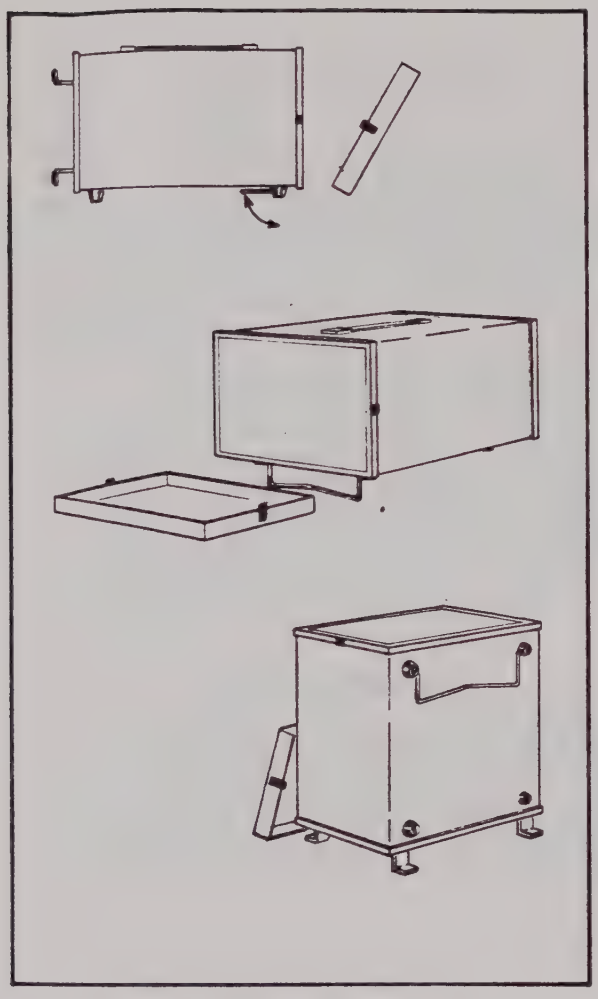


Figure 2-2. Bench Mounting.

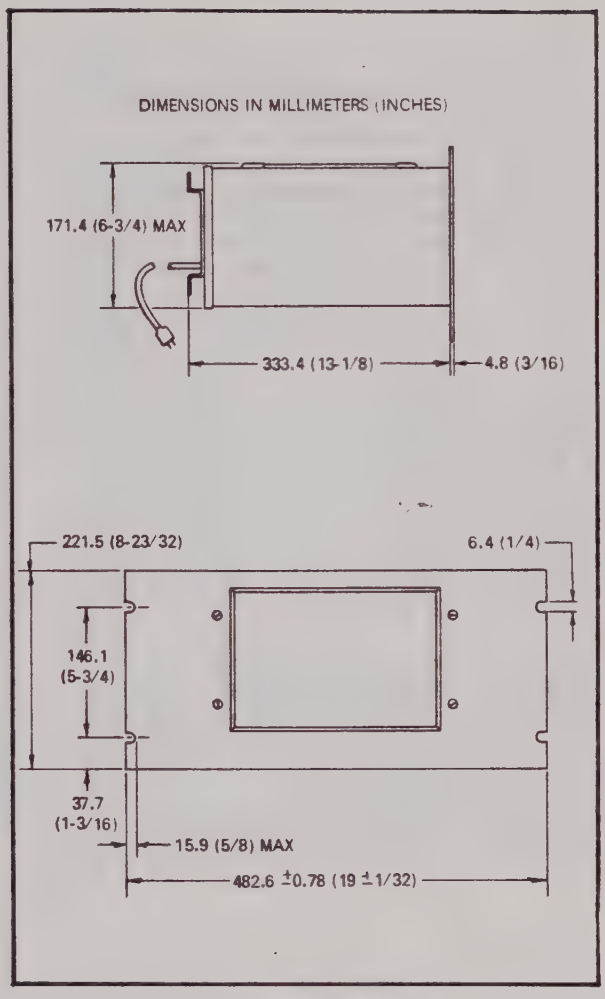


Figure 2-3. Rack Mounting.

2-27. Mounting.

2-28. The Model 1200B is designed primarily for bench top operation, but has also been adapted for field usage. The instrument is equipped with non-skid neoprene pads for horizontal or vertical use. A tilt bail is provided for ease of operation in the horizontal position. See Figure 2-2.

2-29. If ordered as a rack mounted instrument, Figure 2-3, the instrument is installed in a mounting enclosure at the factory. The enclosure is shipped with universal mounting flanges attached, ready for installation in a standard 19 inch cabinet. Mounting screws are packaged with the instrument.

CAUTION

Ambient temperature in rack during operation should not exceed the maximum specified. Make certain that position in rack permits ample air circulation around the instrument and that nearby instruments do not discharge hot air directly into it.

2-30. STRAIN GAGE CONNECTION DATA.

2-31. General.

2-32. Strain gages are connected to the indicator with extension lead wires. Installation of these wires is critical and must be done very carefully. Gravity, thermal and mechanical shock, or careless handling can ruin a gage installation by transmitting these forces to the sensing element through the lead wires.

2-33. To reduce this risk, a small terminal strip is mounted at a location near the gage installation. The intermediate gage leads are then connected between the terminal strip and the indicator. Several kinds of terminals are available for this purpose. Proper installation techniques for each are detailed in the BLH Strain Gage Handbook, available to users at no cost. Some general guidelines are presented in the following paragraphs. See Figure 2-4 for a typical installation.

2-34. Methods of Attachment.

2-35. There are two primary methods of attaching lead wires to the terminal strip; soldering or welding. Soldering is the most popular and most widely used. For most strain gage work, the solder used should be 60-40 tin-lead. This solder has a melting point of 182°C (360°F) and mechanical strength is generally good. Wetting and flow characteristics are very good on most metals.

2-36. The low-temperature performance of tin-lead solder, however, is very poor. The alloy becomes brittle at temperatures below -18°C (0°F) because of tin content. This will weaken the connection drastically and is, therefore, unsuitable for cryogenic applications. Lead-tin-silver combinations are more suited to low temperature installations, straight tin-silver alloys being preferred for high temperature work to about 218°C (450°F).

2-37. Non-corrosive flux is recommended where ever possible. On most metals, a pure rosin flux will provide a clean, tarnish-free surface during soldering and will insure proper wetting of the surface For stainless steel and other metals difficult to solder, an organic flux should be used. In these cases it is imperative that all traces of the flux be washed away after soldering. Corrosive flux left on the terminals will cause corrosion and leakage to ground problems resulting in erratic readings.

2-38. Welded joints are usually employed in installations where the operating temperature is too high for soldered connections. In such installations, weldable terminals TB-550 or TC-1200 are recommended for use as junction points between the gage leads and the main lead system to prevent gage damage. See the Strain Gage Handbook for special precautions and specific welding techniques.

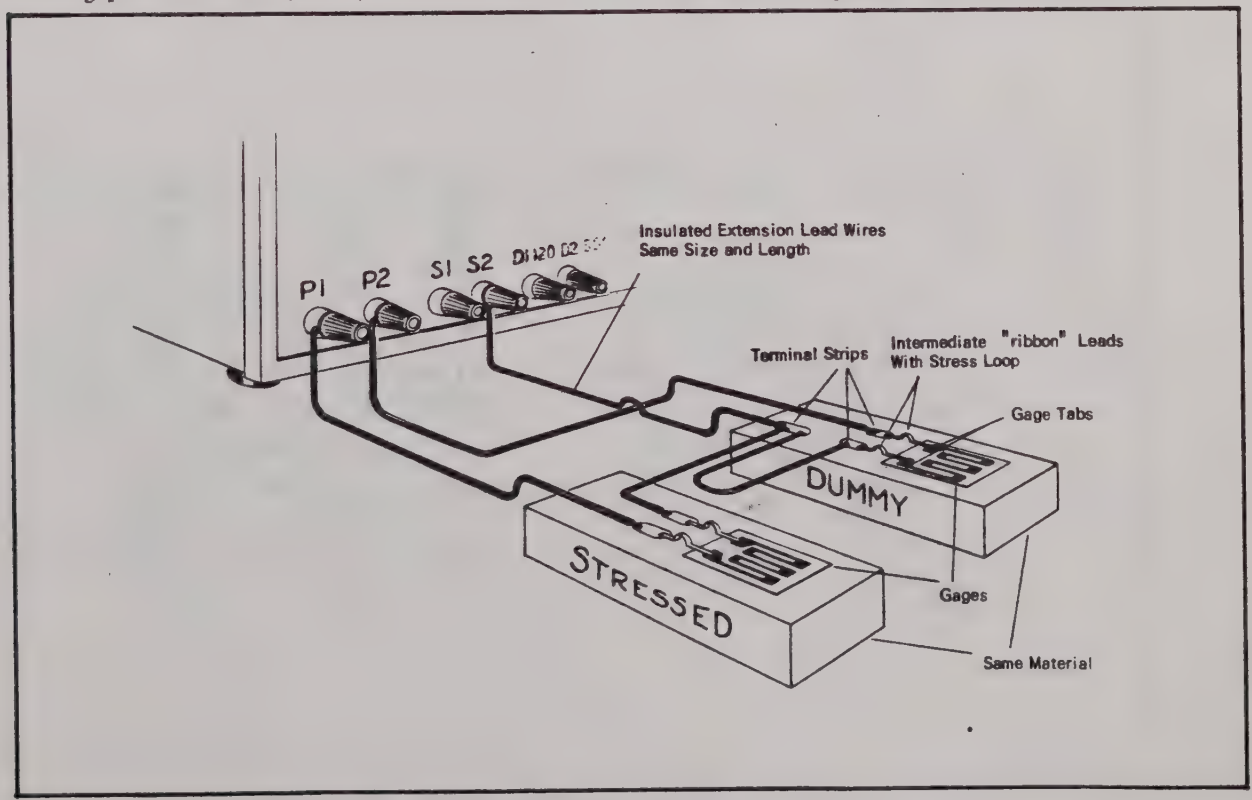


Figure 2-4. Typical Half-Bridge Installation.

2-39. Temperature Effects on Lead Wires.

2-40. When half and full bridge configurations are connected to the instrument as shown in the diagrams, resistance changes in the lead wires caused by temperature variations are eliminated. Note that wires must be of the same length and located sufficiently close together to insure self-cancellation of temperature induced resistance changes.

2-41. Quarter bridge (single gage) configurations, however, will be affected if the extension leads are long and terminal S2 is connected to D1 or D2 with a short length of lead wire as shown in Figure 2-5. Essentially, this would be a two-wire system.

2-42. To compensate for possible temperature effects, connect a third lead wire between Terminal D1 or D2 and the gage rather than directly to S2 as shown in Figure 2-5. The third lead wire must be of the same size and length as the other two in order to be effective.

2-43. Strain Gage Extension Leads.

2-44. Gage lead extension wires should be soldered or welded to the gages depending upon the application and type of gage used as described in the preceding paragraphs. For binding post connections at the instrument, lead extensions should be soldered to clean, tinned spade lugs. If stranded lead-wire is used, all strands should be intact and care should be taken to solder all strands to the spade lug. In locations where strong electrical disturbances are present, shielded cable should be used for long extension leads. The shield should be grounded at only one point. See Strain Gage Handbook for other lead wire considerations.

2-45. Lead Wire Resistance.

2-46. In most applications, the effect of lead wire resistance on strain measurements will be negligible. When long, or small-diameter, leads are used, however, the added resistance of the leads, in series with the strain gage, reduces the effective gage factor in proportion to the ratio of lead wire to gage resistance. Resetting the gage factor control will correct measurement errors introduced by load wire resistance. To illustrate, assume that a 120Ω gage is connected to the Indicator by two 75-foot leads of #20 AWG copper wire. Number 20 copper wire has an approximate resistance of 10 ohms per 1000 feet. The total lead wire resistance in series with the gage will, therefore, be 1.5Ω, which will reduce the effective gage factor by the ratio of 1.5:120 or 1.25 percent. The correction is made by setting the instrument gage factor control 1.25 percent low or a 98.75 percent of the value marked on the gage package. An alternative method would be to set the conditioner to the gage factor marked on the package, and multiply all measured strains by 1/0.9875.

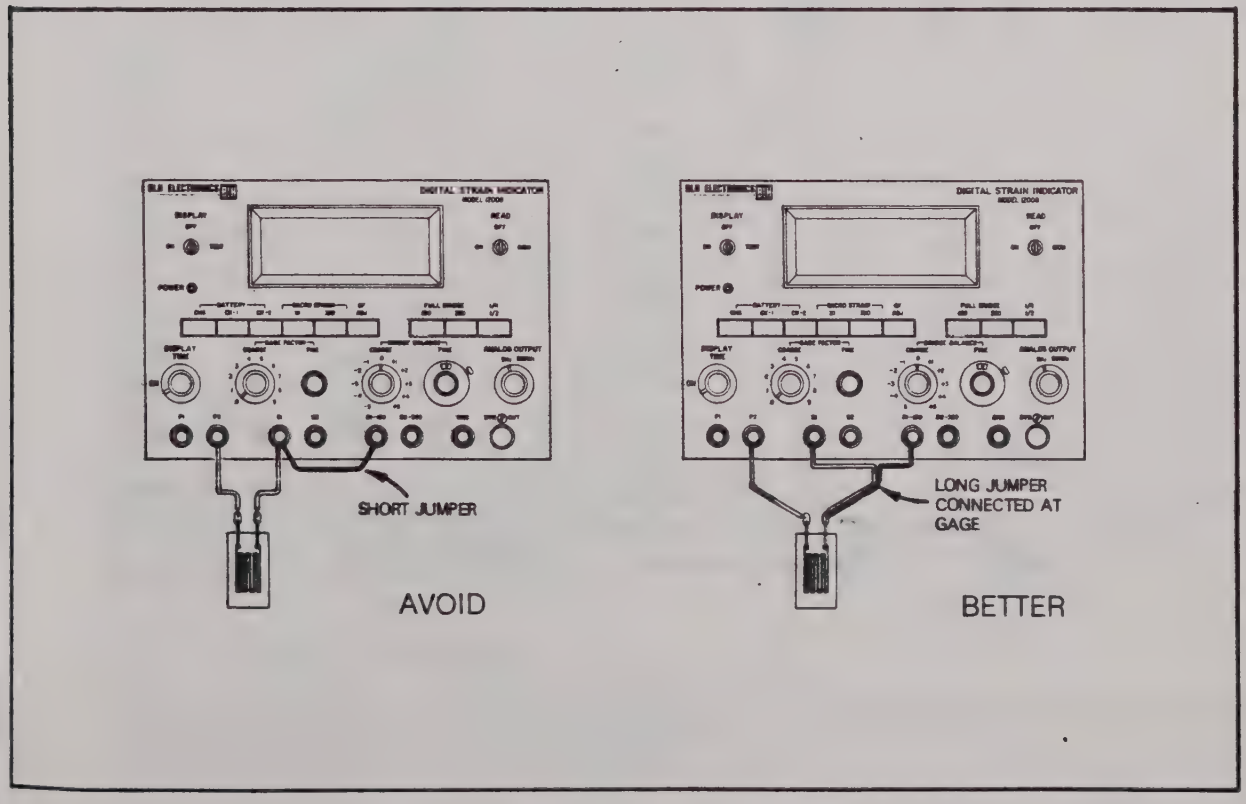


Figure 2-5. Quarter-Bridge Connections.

2-47. Temperature Effect on Lead Wire.

2-48. Table 2-1 is a general listing of locally obtainable materials that have been found suitable for BLH strain gage use. For other than BLH strain gage use, consult the manufacturer. Table 2-2, Lead Wire Selection Chart, is a complete coded listing with appropriate catalog number of lead wire and cable stocked by BLH. These materials are available through any BLH Sales/Service Office or directly from the factory.

Table 2-1. Gage Lead Conductors and Insulators

CONDUCTORS	Operating Temperature °C (F)	
	Stable to	Maximum
Nickel Clad Copper	371 (700)	538 (1000)
S.S. Clad Copper	427 (800)	704 (1300)
Nickel Clad Silver	538 (1000)	816 (1500)
Nichrome	371 (700)	927 (1700)

INSULATORS	Temperature Range °C (F)	
	From	To
Nylon	Below-73 (-100)	121 (250)
Nylon, Vinyl	Below-73 (-100)	66 (150)
Nylon, Polyethylene	Below-73 (-100)	93 (200)
Teflon	Below-73 (-100)	260 (500)
Glass Impregnated Sl.	Above 260 (500)	316 * (600)
Glass Sleeving	Above 260 (500)	316 * (600)

* Electrical insulation breakdown varies with the glass used. Exercise caution when selecting glass for use above 316° (600°).

2-49. Other Sources of Signal Error.

2-50. In addition to the temperature and lead wire resistance effects noted in the preceding paragraphs, signal errors can also be caused by mechanical stresses in lead wires and by gage overheating.

2-51. MECHANICAL STRESSES. It is possible for stresses produced in lead wires by their own weight to influence the output signal of the gage bridge. Tie down long leads and provide strain reliefs wherever possible.

2-52. GAGE OVERHEATING. If the gages are mounted on a poor heat sink, plastics for example, the current flowing through the gage may cause overheating of the filament. This can influence the signal output. This condition can be alleviated by applying excitation to the gages only when a reading is to be taken or by reducing excitation voltage.

2-53. SPECIFIC APPLICATIONS.

2-54. Three-Wire Half-Bridge.

2-55. To cancel the effects of temperature on the gage, a circuit like that shown in Figure 2-6 is used. The measuring or "active" gage is mounted on the test specimen and the compensating or "dummy" gage is mounted on an unstressed piece of the same material. Both gages are subjected to the same changes in temperature during the course of measurement. Resistance changes due to temperature alone will be the same for both of the Wheatstone bridge arms in which these gages are located (the remaining two arms are located within the instrument and will not affect the stress-induced strain at the measuring gage). Connect the gages to the instrument as shown in Figure 2-6. Two common types of half bridge are shown. Each, however, is essentially the same. See Figure 3-1 for operating instructions.

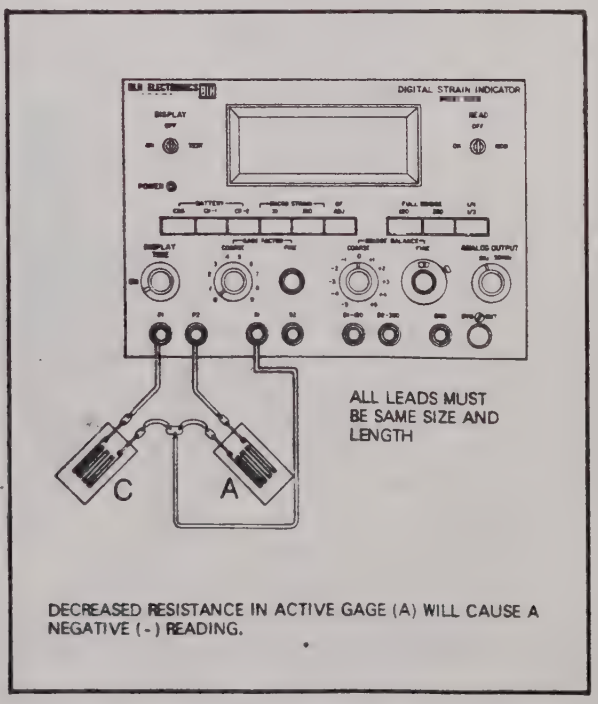

DIGITAL STRAIN INDICATOR
ALL LEADS MUST BE SAME SIZE AND LENGTH
C
A
DECREASED RESISTANCE IN ACTIVE GAGE (A) WILL CAUSE A NEGATIVE (-) READING.

Figure 2-6. Typical Half-Bridge Connection.

Table 2-2. Lead Wire Selection Chart

SR-4 STRAINLINE
LEAD WIRE CODE & SELECTOR CHART

LEAD WIRE DESIGNATION CODE

ST C – 26 V – 3 RWB

TYPE
ST – Stranded
SD – Solid
RB – Ribbon

SIZE
American Wire Gage
No. or Ribbon Thickness
and Width in Thousandths
of Inch

NO. OF CONDUCTORS
1
2
3
4

COLOR
R – Red
W – White
B – Black
G – Green

MATERIAL
AU – Gold
C – Copper
NCC – Nickel Clad Copper
SSC – Stainless Steel Clad Copper
CON – Constantan
NIV – Nichrome V

INSULATION
V – Poly-Vinyl-Chloride
T – Teflon
SE – Solder-eze Varnish
F – Fiberglas
U – No Insulation

DESIGNATION	TEMP. RANGE °C (F)	APPROX. OHMS/FT/COND	CATALOG NUMBER
STC-26V-1R, W, B, G, (Specify one color)	-73 to +79 (-100 to +175)	.04Ω/FT.	218909(B) 218911(R) 218912(G) 218910(W)
STC-26V-3RWB		.04Ω/FT.	218960
STC-26V-4RWBG		.04Ω/FT.	218961
STC-30V-3RWB		.1Ω/FT.	218962
STC-36V-4RWBG		.4Ω/FT.	218963
SDC-27SE-1	-101 to +149 (-150 to +300)	.05Ω/FT.	218964
SDC-34SE-1		.3Ω/FT.	218965
STC-26T-1R, W, B, G, (Specify one color)	-268 to +260 (-450 to +500)	.04Ω/FT.	218907(R) 218905(B) 218906(W) 218908(G)
STC-26T-3RWB		.04Ω/FT.	218967
SDC-36T-1R, W, B, G, (Specify one color)		.4Ω/FT.	218969(R) 218971(B) 218970(W) 218968(G)
RBCON 4x31U-1		2.4Ω/FT.	103153
RBNCC-2x12U-1	to +482 (+900)	.3Ω/FT	216361
RBNCC-2x8U-1		.5Ω/FT.	216362
SDNCC-26F-1		.04Ω/FT.	218972
SDSSC-26F-1	to +593 (+1100)	.04Ω/FT.	218974
SDNIV-26F-1	to +704 (+1300)	2.5Ω /FT.	218973
SDNIV-30U-1		6.5Ω/FT.	218501
RBNIV-3x15U-1		14.5Ω/FT.	103152

MISCELLANEOUS

22F (Fiberglas Sleeving)	704 (1300)		218502
24F (Fiberglass Sleeving)	1093 (2000)		219012
SDAu-XU-1 (.003" Gold)	871 (1600)	33.5Ω/FT.	214128

CABLE

Four Cond. shielded #20 AWG (Teflon insulated, neoprene jacket)	-40 to 100 (-40 to 212)		103998
Four cond. shielded #16 AWG (All Teflon insulation)	-29 to 249 (-20 to 480)		100110

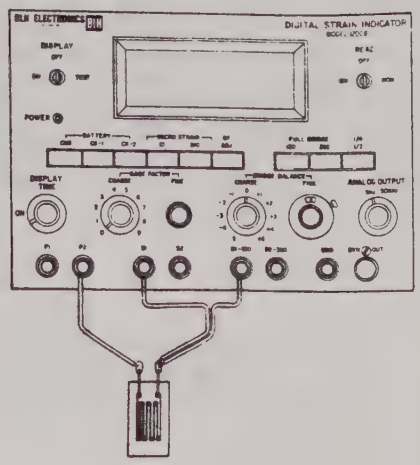
2-56. Four Arm.

2-57. In the four-arm (full bridge) configuration, four strain gages are connected in the form of a Wheatstone bridge, in which any or all of the gages may be active. This particular arrangement has been used effectively where strains to be measured are very small. In operation, the bridge is unbalanced in proportion to the difference in the strains of active gages located in adjacent arms and in proportion to the sum of the strains of active gages located in opposite arms.

2-58. If the four-arm bridge is used with the Model 1200 connect the two input voltage leads to the Black and Green terminals. Connect the gage bridge signal output leads to the Red and White front panel terminals S1 and S2 (+). See Figure 2-7 for connection data and Figure 3-1 for operating instructions.

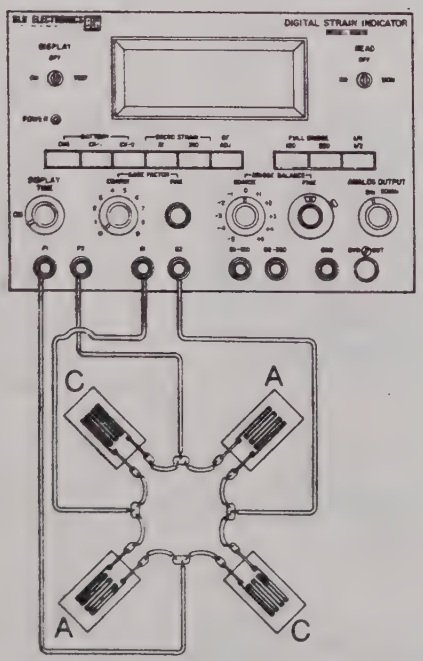
2-59. Quarter-Bridge.

2-60. Use of the self-compensated strain gage eliminates the need for a compensation gage in most cases. To avoid lead wire induced errors BLH recommends that the "three-wire" method of resistance measurement be used (see paragraph 2-42). To use the three-wire system with the indicator, connect the gage to the instrument as shown in Figure 2-8 or 2-9. See Figure 3-1 for operating instructions.



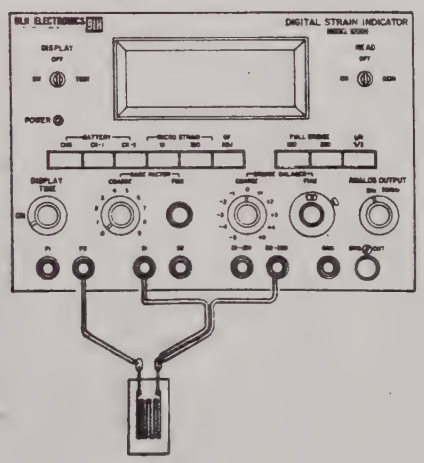
INCREASING RESISTANCE (TENSILE STRAIN) IN THIS GAGE WILL CAUSE (+) INDICATION.

Figure 2-8. 120 Ohm Quarter-Bridge.



DECREASE RESISTANCE IN C GAGE GIVES NEGATIVE RESISTANCE

Figure 2-7. Four-Arm, Full-Bridge Configureation.



INCREASING RESISTANCE (TENSILE STRAIN) IN THIS GAGE WILL CAUSE (+) INDICATION.

Figure 2-9. 350 Ohm Quarter-Bridge.

2-61. Connecting and Switching Multiple Gage Groups.

2-62. The BLH Model 1225 Switching and Balancing Unit allows a group of up to ten half or full bridge outputs to be monitored in succession on one strain indicator. When monitoring of more than 10 bridges is necessary, two or more switching and balancing units can be stacked and their output terminals connected in parallel to the indicator. This provides an additional number of channels. Refer to the Model 1225 Operating and Service manual for instructions.

NOTE

When the 1225 Switching and Balancing Unit is used, the indicator must be calibrated through it. See Maintenance, Section V of this manual, for complete instructions.

2-63. Transducer Operation.

2-64. The Indicator can be used to measure the response of any BLH wire or foil strain gage load or pressure transducer. The bridge circuits of these cells are adjusted to a standard output and are all fully compensated for temperature. Connect the transducer to the terminals as shown in Figure 2-10. Refer to Section III of this manual for initial adjustments and detailed operating instructions.

2-65. Dynamic Strain.

2-66. Output is approximately ±1.000V for 10,000 microinches per inch. Maximum dynamic output is ±5V. It is not practical, however, to attempt dynamic strain readings with a DVM-type readout device. Dynamic strain should be monitored at the DYN OUT jack with an oscilloscope or recorder. The jack mates with H.H. Smith 3-conductor phone plug No. 308 or 309. Connections are as shown below. The 308 plug has solder terminals. The 309 plug has screw terminals.

2-67. FINAL WIRING CHECK. After all wiring is completed, check terminations for proper soldering and tight terminal connections. Check and tighten each terminal to assure full engagement and proper seating. Provide strain reliefs where necessary.

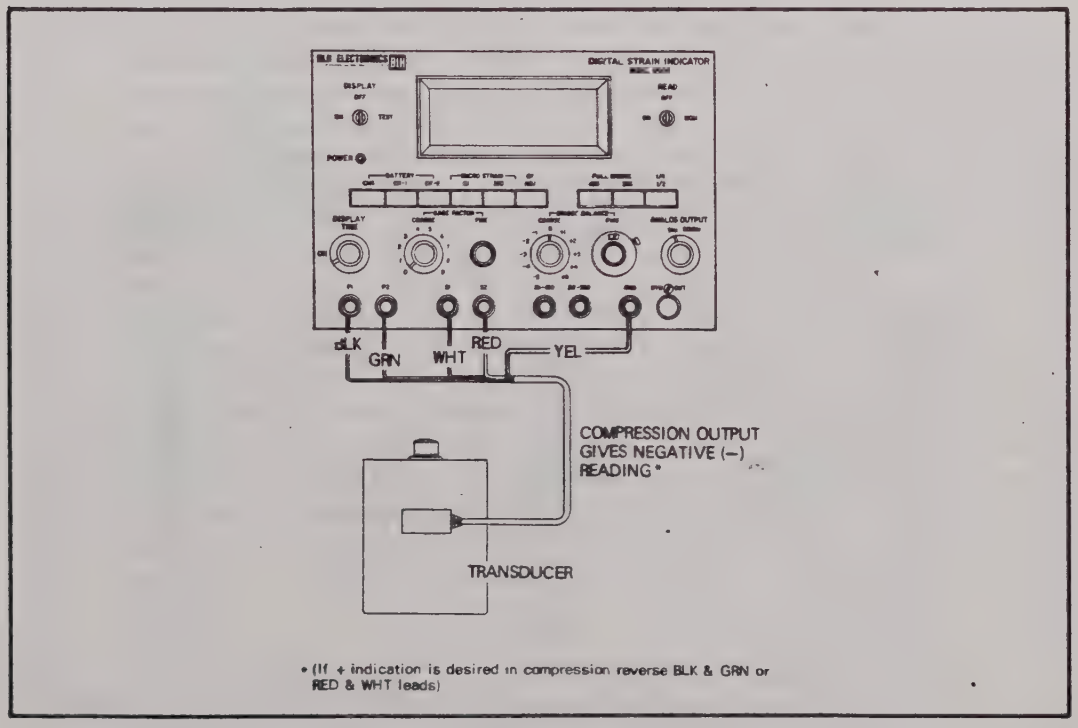
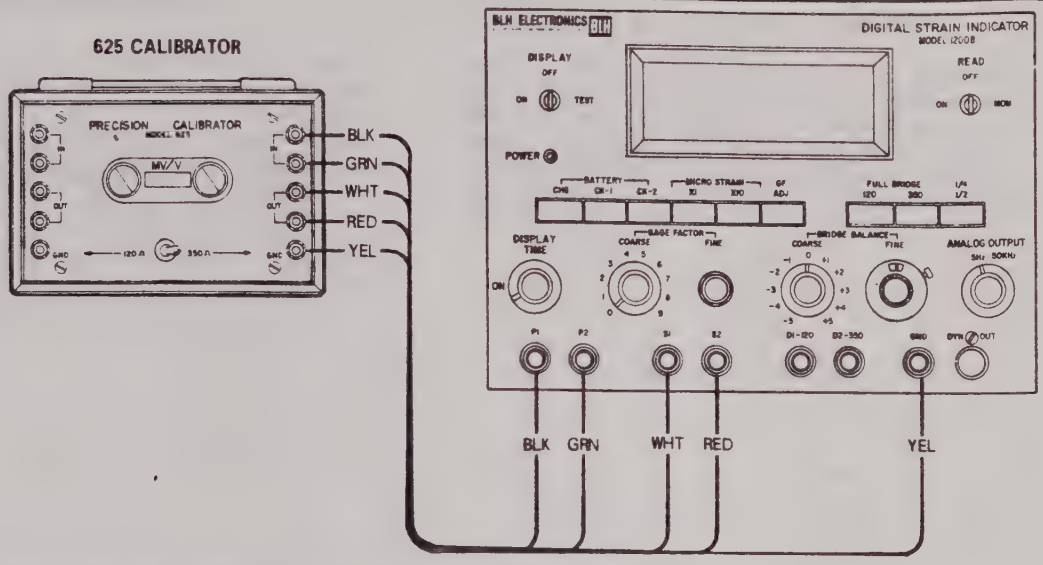


Figure 2-10. Transducer Operation.



1. Connect Model 625 Calibrator to front panel of instrument as shown.
2. Press FULL BRIDGE 350Ω button on Model 1200. Place Model 625 bridge selector switch in the 350Ω position.
3. Turn DISPLAY TIME control clockwise until POWER indicator lights.
4. For ac powered units, set the DISPLAY and READ switches to CN. For battery powered units, set the DISPLAY switch to CN and the DISPLAY TIME control to minimum time necessary to read display, then set READ switch to MOM each time reading is desired, in order to conserve batteries (see paragraph 2-24).
5. Press GF ADJ button until display indicates 2.000.
6. Select X1 or X10 range. Adjust BRIDGE BALANCE controls for 0000 display.
7. Apply increments of 1000μin/in with Model 625 (see table). Linearity should be ±0.04% of reading ± 1 digit over each step. At each step, switch between the X1 and X10 ranges. Last digit in display should not vary more than ±4 counts at any point.

CONVERSION TABLE - MICROINCHES-PER-INCH TO MILLIVOLTS-PER-VOLT *

μ INCHES	Mv/V	μ INCHES	Mv/V	μ INCHES	Mv/V
0	0	1400	.70	4000	2.00
100	.05	1500	.75	4500	2.25
200	.10	1600	.80	5000	2.50
300	.15	1800	.90	5500	2.75
400	.20	2000	1.00	6000	3.00
500	.25	2200	1.10	6500	3.25
600	.30	2400	1.20	7000	3.50
700	.35	2500	1.25	7500	3.75
800	.40	2600	1.30	8000	4.00
900	.45	2800	1.40	8500	4.25
1000	.50	3000	1.50	9000	4.50
1200	.60	3500	1.75	9500	4.75
				10 000	5.00

*(Simulates full, four-arm, active gage bridge; Gage Factor set to 2.000)

Figure 2-11. Calibration Check

2-68. CALIBRATION CHECK.

2-69. The instrument has been calibrated and inspected at the factory before shipment and is ready for operation as received. If desired, a pre-operational calibration check can be quickly performed as described in Figure 2-11. Figure 3-1, in Section III, provides a detailed listing of the Model 1200B operating controls and indicators. The calibration check procedure is recommended as an incoming QC check and should be performed periodically by the operator. If an instrument component is repaired or replaced, however, the instrument must be recalibrated as described in Section V.

2-70. BCD OUTPUT CONNECTIONS.

2-71. When the Model 1200B Strain Gage Indicator is supplied with the BCD output option, a connector, J1, is installed on the instrument rear panel to provide a four-digit BCD data output which is derived from the instrument's BCD latch circuits. Figure 2-12 provides the detailed pin data for rear panel connector J1.

J1

J1			
PIN	FUNCTION	PIN	FUNCTION
36	+5 Volts	17	Digit 2, Bit 4
35	Trigger	16	Digit 2, Bit 2
31	Ground	15	Digit 2, Bit 1
29	Digit 4, Bit 8	14	Digit 1, Bit 8
28	Digit 4, Bit 4 (LSD)	13	Digit 1, Bit 4 (MSD)
27	Digit 4, Bit 2	12	Digit 1, Bit 2
26	Digit 4, Bit 1	11	Digit 1, Bit 1
25	Digit 3, Bit 8	8	Over Range
24	Digit 3, Bit 4	6	Full Scale Count
20	Digit 3, Bit 2	4	+ Polarity
19	Digit 3, Bit 1	3	- Polarity
18	Digit 2, Bit 8		

Figure 2-12. BCD Output Connector Data

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SECTION III
OPERATING

3-1. OPERATING CONTROLS, INDICATORS AND CONNECTORS.

3-2. A detailed description of the Model 1200B operating controls, indicators and connectors is provided in Figure 3-1.

3-3. OPERATING PROCEDURES.

3-4. Introduction.

3-5. Figure 3-2 presents a standard operating procedure. The illustration of the front panel in Figure 3-2 is used to highlight the sequential operation. The circled numbers on the controls are keyed to the steps in which the controls are used. If other readout devices are used to monitor the load, they should be calibrated according to the manufacturer's instructions before operation.

3-6. Paragraphs 3-7 through 3-16, following, explain special operating procedures.

3-7. Half Bridge Operation.

3-8. When an active and compensating gage or two active gages are connected to the instrument in a two-arm half bridge, the 1/4 - 1/2 button must be pressed, regardless of the actual resistance of the gages in the half-bridge.

3-9. When the switch is placed in this position, two bridge completion resistors of the appropriate value are placed into adjacent arms of the gage circuit completing, internally, a Wheatstone bridge. Initial bridge imbalance is cancelled with the COARSE and FINE BRIDGE BALANCE controls.

3-10. Full Bridge Operation.

3-11. The Bridge Selector Switch maintains the full balancing range of the instrument at each of the full bridge (four-arm) settings (120 and 350 ohms). If the initial imbalance of the gage bridge is greater than the zero range of the instrument at the 350 ohm setting, the zero range can be increased by pressing the 120 ohm button.

3-12. Transducer Operation.

3-13. The mV/V output of a BLH wire or foil strain gage transducer will be displayed in microinches per inch when the GAGE FACTOR controls are set for 2.000. This setting is the same for both 2mV/V and 3mV/V transducers.

3-14. At the above gage factor setting, the full scale output of a 2mV/V transducer will appear in the digital display as 4000 microinches per inch and a 3mV/V transducer as 6000 microinches per inch (1mV/V = 2000 microinches per inch). Readout will be linear (i.e. at half of full scale load, a 2mV/V transducer output will be displayed as 2000 microinches per inch; at quarter of full scale load, 1000 microinches per inch, etc.).

3-15. It may be more desirable, however, to have the instrument indicate transducer output in engineering units (pounds, inches, units of flow, etc.), rather than in microinches per inch. A 2mV/V, 5000 pound capacity load cell, for example, will normally display a full scale readout of 4000 microinches per inch at the gage factor setting of 2.000 as stated in paragraph 3-13 ~~3-11~~. If it is more convenient to have a full scale readout of 5000 counts (to coincide with the 5000 pound full scale output) proceed as follows:

a. Check calibration of the Model 1200 as described in Figure 2-11.

b. Press the GF ADJ button and adjust the GAGE FACTOR CONTROLS until the digital display indicates 2.000.

c. Press the MICRO IN/IN X1 button and apply load to the transducer until a full scale readout of 4000 microinches per inch is obtained. (A Model 625 Calibrator can be used to simulate a full scale reading in lieu of the actual transducer).

d. With the MICRO IN/ IN X1 button still depressed, adjust the GAGE FACTOR controls until the digital display indicates 5000 counts.

Every count in the digital display will now be equivalent to 1 pound of applied force on the transducer. Readout will remain linear; at half scale, display will indicate 2500, at quarter scale, 1250, etc.

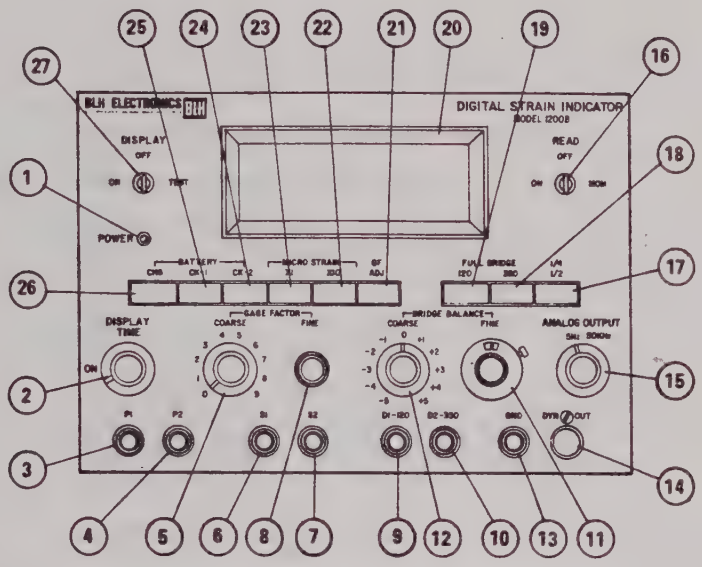
3-16. The procedure is similar for transducers with full scale outputs other than 2mV/V. A 3mV/V full scale output transducer, for example, is first loaded to indicate 6000 microinches per inch at a gage factor setting of 2.000. The GAGE FACTOR controls are then adjusted for the desired readout in engineering units.

NOTE

DECREASING the GAGE FACTOR setting INCREASES the readout indication; INCREASING the GAGE FACTOR setting DECREASES the readout indication without loss of linearity within the specified gage factor range.

3-17. Initial Calibration Check.

3-18. An initial calibration check to verify adjustment can be performed prior to placing the system in operation. Figure 2-11 illustrates the procedure. Further calibration data is provided in Section V of this manual.

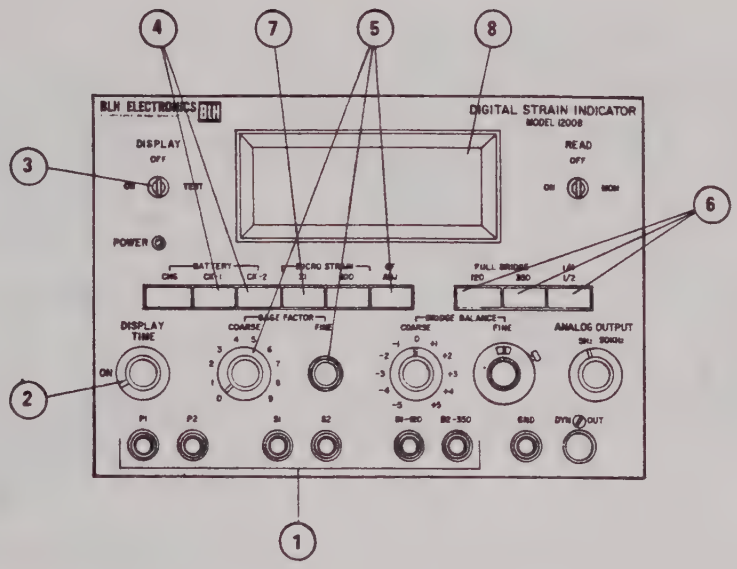


1	Power Light	Light emitting diode. Glows when 4.8V bridge excitation voltage is being generated.
2	DISPLAY TIME switch/control	The switch section applies line voltage to the gages. In battery operated instruments, when the READ switch (Ref. No. 16) is set to the MOM position and then released, the setting of the control section then determines the time duration of the resulting meter display. This will vary from a minimum of approximately 2 seconds to a maximum of approximately 15 seconds depending upon the setting of the DISPLAY TIME control.
3	P1 Terminal (Black)	Bridge excitation terminal.
4	P2 Terminal (Green)	Bridge excitation terminal.
5	CCARSE GAGE FACTCR Switch	Provides coarse gage factor setting for gages in use. (Used in conjunction with Ref. No. 8.)
6	S1 Terminal (White)	Negative signal input terminal.
7	S2 Terminal (Red)	Positive signal input terminal.
8	FINE GAGE FACTOR Control	Provides fine gage factor setting for gages in use. (Used in conjunction with Ref. No. 5.)
9	D1-120 (ohm) Terminal (Blue)	120 ohm quarter bridge and signal terminal.
10	D2-350 (ohm) Terminal (Blue)	350 ohm quarter bridge and signal terminal.

Figure 3-1. Operating Controls, Indicators and Connectors.

11	BRIDGE BALANCE-FINE Control	Ten-turn calibrated control provides no-load strain gage bridge balance fine adjustment.
12	BRIDGE BALANCE-COARSE Control	Eleven position selector switch provides no-load strain gage bridge balance coarse adjustment.
13	GND Terminal (Yellow)	Cable shield terminal. (Chassis is ground.)
14	DYN OUT Jack	External connection point for measurement of dynamic (oscillatory) signals with oscilloscope or recorder. NOTE: If an external instrument is connected to the DYN OUT jack and the ANALOG OUTPUT switch (Ref. No. 15) is in the 50KHz position, any reading called up on the digital display (Ref. No. 20) is not valid.
15	ANALOG OUTPUT Selector Switch	Selects either a filtered (5Hz) or unfiltered (50KHz) analog signal as the signal at the DYN OUT jack (Ref. No. 14).
16	READ Switch	Three position switch (ON/OFF/MOM), used (in conjunction with DISPLAY switch, Ref. No. 27) to obtain read-outs on digital display for battery operated instruments. If the READ switch is set to ON, display is continuous. If READ switch is set to MOM position (spring-loaded) and released, display remains on for approximately 2 to 15 seconds, depending on setting of DISPLAY TIME control (Ref. No. 2.).
17	1/4 - 1/2-Bridge Selector Switch	Places proper bridge completion resistors in circuit when using 1/4 or 1/2 bridge configuration.
18	FULL BRIDGE 350 ohm Selector Switch	Places proper bridge balancing network in circuit when 350 ohm full bridges are used.
19	FULL BRIDGE 120 ohm Selector Switch	Places proper bridge balancing network in circuit when 120 ohm full bridges are used.
20	Digital Display	Four 0.5" high light emitting diode digits. Automatic with + and - polarity. Also displays battery voltage and GF settings on command. Overrange digit "1" appears to the left of the MSD at measurements in excess of 9999 microinches per inch.
21	GF ADJ Selector Switch	Displays gage factor set into instrument with coarse and fine gage factor controls. Resolution is 0.001.
22	MICROSTRAIN X10 Selector Switch	When depressed, indicator will measure strain to 100,000 micro-inches per inch. Figure displayed must be multiplied by 10 for actual strain. Resolution is ±10 microinches per inch.
23	MICROSTRAIN X1 Selector Switch	When depressed, indicator displays actual strain up to 10,000 microinches per inch with a resolution of ±1 microinch.
24	BATTERY CK2 Selector Switch	When depressed, combined negative voltage level of the four 1.2V nickel cadmium batteries is displayed; -4.8V is nominal. Recharge below -4.1V (4100 on display).
25	BATTERY CK1 Selector Switch	When depressed, combined positive voltage level of the four 1.2V nickel cadmium batteries is displayed; +4.8V is nominal. Recharge below +4.1V (4100 on display).
26	BATTERY CHG. Selector Switch	When depressed, activates battery charging circuit. Depress to charge batteries whenever BATTERY CK1 or BATTERY CK2 displays a reading below 4100. Strain readings cannot be taken while batteries are being charged.
27	DISPLAY Switch	Three position switch (ON/OFF/TEST). ON position provides meter display when instrument is operating off 115 or 230Vac line power. TEST (spring-loaded) position provides meter check (with instrument on line power) by causing meter to read 18888. In battery-powered operation this switch must be in ON position and READ switch operated as described.

Figure 3-1. Front & Rear Panel Control Data (Cont.).



1 Select quarter, half bridge or full bridge configuration desired and connect gages to binding posts of indicator as described in Section II of this manual.

2 Turn DISPLAY TIME control clockwise until POWER indicator lights. For battery operated units, set to minimum time necessary to read display in order to conserve batteries (see paragraph 2-24).

3 Set DISPLAY switch to ON.

4 For battery operated units, press BATTERY CK-1 and CK-2 switches. Display should indicate 4100 or better. If not, plug in instrument and press CHG button.

> **IMPORTANT**
>
> Battery operated instruments will not indicate until READ switch set to MOM. When read switch is set to MOM, reading will appear in digital display for approximately 1 to 15 seconds, depending upon the DISPLAY TIME setting.

5 Press GF ADJ button and adjust GAGE FACTOR controls until gage factor of gages in use (marked on package) appears in digital display.

6 Press BRIDGE SELECTOR button for configuration in use, 120Ω, 350Ω or 1/4-1/2 bridge (disregard resistance for 1/4 and 1/2 bridges).

7 Select X1 or X10 scale with micro in./in. switch. Cancel initial bridge imbalance with COARSE and FINE BRIDGE ZERO controls.

8 Load gages or transducer.

9 Read display.

Figure 3-2. Instrument Operation.

SECTION IV
PRINCIPLES OF OPERATION

4-1. INTRODUCTION

4-2. The Model 1200B Strain Gage Signal Conditioner is designed to amplify and display, in microinches per inch, a change in voltage caused by resistance changes in wire and foil strain gages. A plug-in power supply produces a precise 4.8V regulated strain gage excitation voltage at front panel terminals P1 and P2.

4-3. Input Configurations (See Figure 4-1.)

4-4. The quarter, half or full strain gage bridge is initially balanced in an unloaded or unstrained condition (with excitation applied) by adjusting the COARSE- and FINE BRIDGE BALANCE controls. When the gages are subjected to strain, the bridge becomes electrically unbalanced and produces a signal at terminals S1 and S2.

4-5. When the bridge selector switch is in the 1/4-1/2 position for quarter or half bridge operation, two 500Ω bridge completion resistors are placed into the measuring circuit as shown. For the 1/4 bridge mode of operation, terminals S1 and D1 are jumpered to insert an additional internal 120Ω resistor for bridge completion, while terminals S1 and D2 are jumpered to insert an additional 350Ω resistor for bridge completion. For the 1/2 bridge mode of operation, an external 120Ω or 350Ω resistor is connected across terminals S1 and P2. In the full bridge (or transducer) mode of operation, all bridge resistances are external and either the FULL BRIDGE - 120 or FULL BRIDGE - 350 setting of the bridge selector switch is selected. Both of these switch positions eliminate the two internal 500Ω bridge completion resistors.

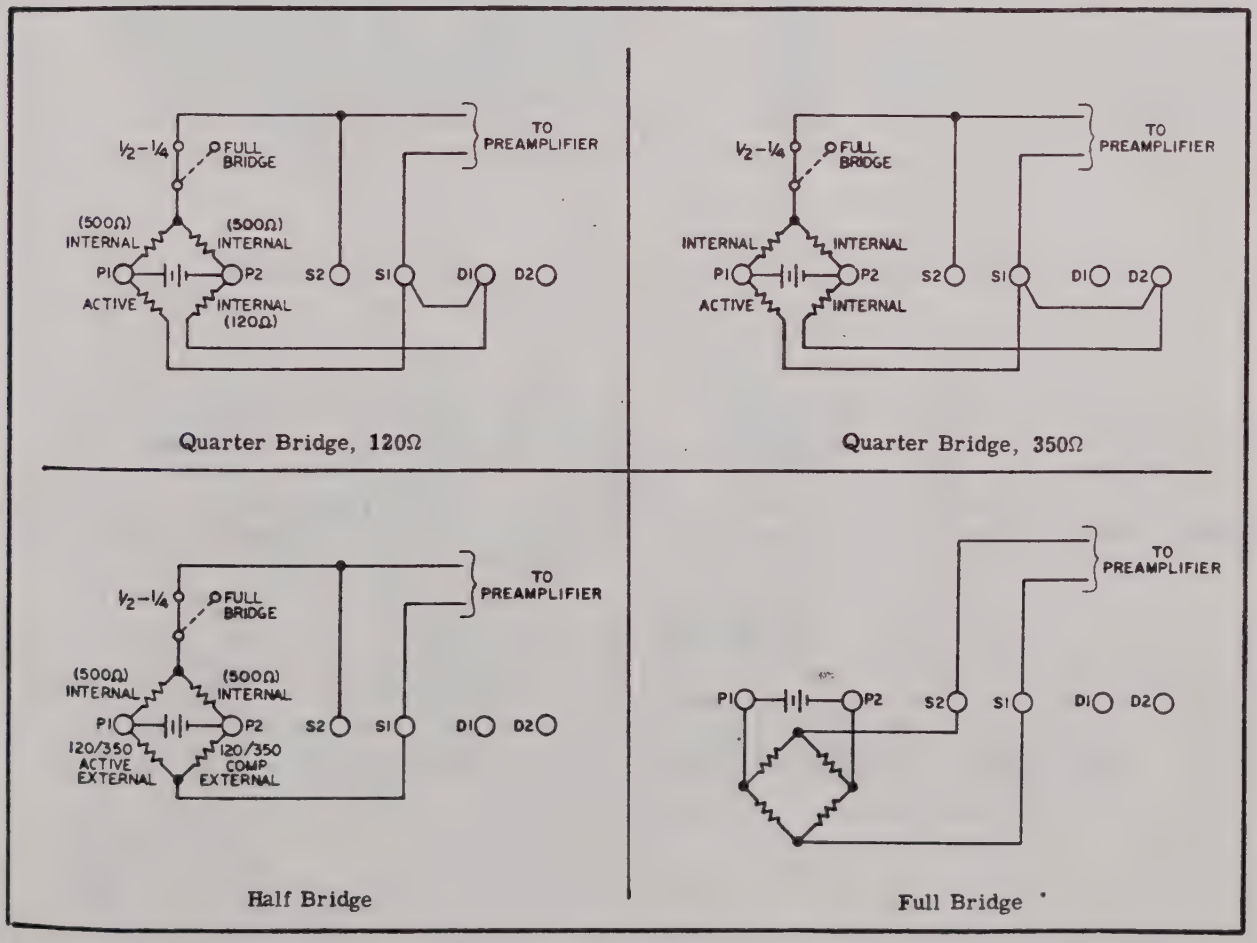


Figure 4-1. Input Configurations.

4-6. Exact bridge balance is reached under zero strain conditions by adjusting the COARSE- and FINE BRIDGE BALANCE controls. Bridge excitation voltage is applied across terminals P1 and P2 and bridge output is monitored across terminals S1 and S2.

4-7. Block Diagram Description (See Figure 4-2).

4-8. The output of the bridge circuit is applied, via an input switch, to a preamplifier circuit where it is amplified and then applied via a coupling capacitor to an output amplifier for further amplification. Both the input circuit and the signal at the output of the coupling capacitor are controlled by the auto zero circuit. The timing of the auto zero circuit is controlled by a full-scale count pulse which originates in the A/D converter. The full-scale count pulse occurs once during each sampling period (which has a duration of 500 msec) and occurs within the sampling period after the A/D converter has completed a full-scale count. When triggered by the full-scale count pulse, the auto zero circuit applies auto zero pulses to both the input circuit and the coupling capacitor. The auto zero pulse applied to the coupling capacitor momentarily grounds the capacitor output returning the signal to zero at the input to the output amplifier. The purpose of the auto zero action is to remove any possible signal drift which may have occurred because of minor changes in the operating characteristics of the input stages. The auto zero pulse applied to the input circuit is used to inhibit application of the bridge output signal while the coupling capacitor is being discharged.

4-9. A signal is tapped off at the output of the preamplifier to provide the signal at the DYN OUT jack. If an instrument is plugged into DYN OUT jack and the ANALOG OUTPUT switch is set to 50KHz, the auto zero circuit function is disabled.

4-10. The A/D converter accepts an analog weight signal from the output amplifier and converts it to a pulse train whose count is directly proportional to the amplitude of the analog weight signal. The pulse train from the A/D converter is applied to the counter/latch circuits. The counter circuits receive the serial pulse output of the A/D converter and convert it to a parallel, four-digit BCD value which is entered into a four-digit latch circuit for temporary storage before application to the decoder circuits. There are four-decoders, each of which accepts the BCD output of a latch circuit and converts it to a seven-line output signal which has been coded to call up the proper digital display data on one of the light emitting diodes (LED's) which comprise the display circuit. There are five LED's in the display

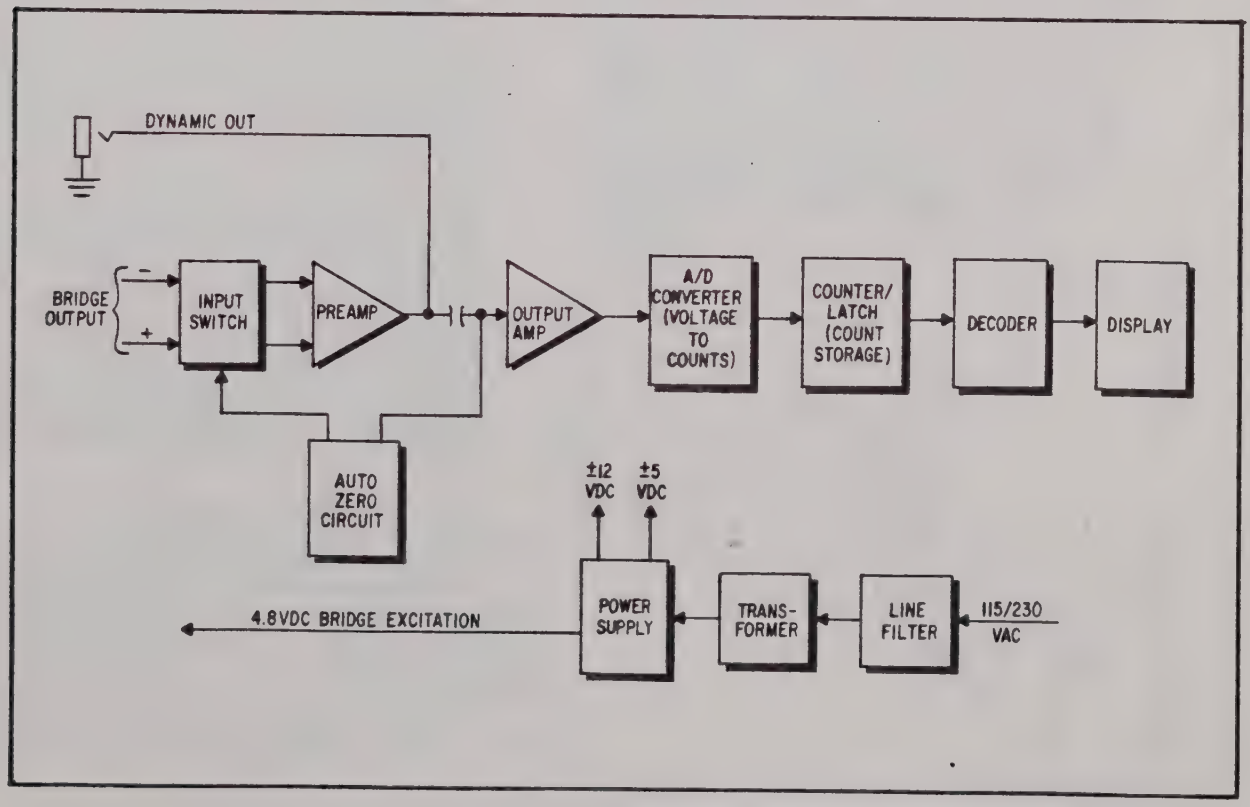


Figure 4-2. Block Diagram.

circuit. Four of them receive the outputs of the decoders and display the selected values for the four least significant digits of the display. The fifth LED receives a polarity signal which is generated in the A/D converter and a count carry signal which is generated by a decoder whenever the digital count exceeds 9999, and produces a display of either ±1 or ±0 depending on the magnitude and polarity of the measured signal.

4-11. Operating Description.

4-12. For the operating description, reference should be made to the schematic diagram at the rear of the manual.

4-13. PREAMPLIFIER. Operation of the preamplifier circuits is largely dependent upon the timed operation of the gated input circuit, IC22. When the measurement cycle starts, IC22 gates the positive signal, present at pin P2-B, through as one input to dual FET Q21. The preamplifier circuits are essentially composed of a two-stage FET buffer amplifier which serves to minimize signal losses. Dual FET Q21, transistors Q22, Q25 and Q26, and integrated circuit IC23 serve as the first stage. Dual FET Q27 and IC24 serve as the second stage. Q21 is a buffer amplifier whose outputs are applied through emitter followers Q25 and Q26 to operational amplifier IC 23. Q22 serves as a constant current source for Q25 and Q26 referenced to Zener diode CR27. The output of IC23 is fed through coupling capacitor C8 to dual FET buffer amplifier Q27 which receives the output signal of IC23 as one input and a feedback signal from IC24 as the second input. Operational amplifier IC24 produces the preamplifier circuit's output signal.

4-14. AUTOMATIC ZERO CIRCUIT. The automatic zero function is controlled by monostable multivibrator IC21. The multivibrator applies a 5-volt level to input gate IC22 which is interrupted by a negative-going pulse approximately 7msec wide at the rate of 2 times per second. When the auto zero pulse occurs, IC22 cuts off the positive input signal to Q21 and also applies a ground to the output of capacitor C18 which is located between the output of IC23 and the input to Q27.

4-15. ACTIVE FILTER CIRCUIT. The active filter circuit is not involved in the processing of signals for any of the Indicator's standard digital displays. In the basic instrument, its only function is to filter the strain signal provided at the DYN CUT jack when the ANALOG OUTPUT selector switch is set to 5Hz. When the instrument is supplied with the peak and hold option, the active filter circuit is employed to filter the strain signal applied to the peak and hold circuits. The purpose of the active filter circuit is to eliminate undesirable frequencies while leaving the useful signal relatively unchanged. The filter reduces to a negligible level signals produced by pulsating cyclic loads such as those produced when monitoring devices containing agitators or vibrators, etc.

4-16. The active components of the active filter circuit are integrated circuits IC1, IC25 and IC26, and transistor Q2. The analog signal from amplifier IC24 is applied through switch IC25 and a filter network consisting of resistors R1, R2 and R3 and capacitors C1, C3 and C6 to Q22. Switch IC25 is controlled by one-shot multivibrator IC26 which is, in turn, triggered by the trigger unit in the automatic zero circuit. Switch IC25 is normally open except during the periods when the automatic zero circuit is active. Transistor Q2 is a dual FET which operates in the same manner as dual FET Q21 in the preamplifier input circuit. Constant closed loop feedback is provided by operational amplifier IC1 which serves to restore the signal level originally present at the input to the active filter circuit compensating for small signal losses during filtration.

4-17. SAMPLE RATE OSCILLATOR. The sample rate oscillator circuit, Figure 4-3 is a relaxation pulse generator located on the A/D converter PC board. The oscillator has a pulse repetition rate of 2 pps. At the beginning of each cycle, the emitter of Q4 is reversed biased to a non-conducting state. As capacitor C28 is charged through resistor R8, the emitter voltage rises exponentially towards the +12V supply voltage. When the emitter voltage reaches a peak point level, the emitter becomes forward biased and the dynamic resistance between the emitter and base-one drops to a low value. Capacitor C28 then discharges through the emitter until the emitter ceases to conduct, and the cycle is repeated.

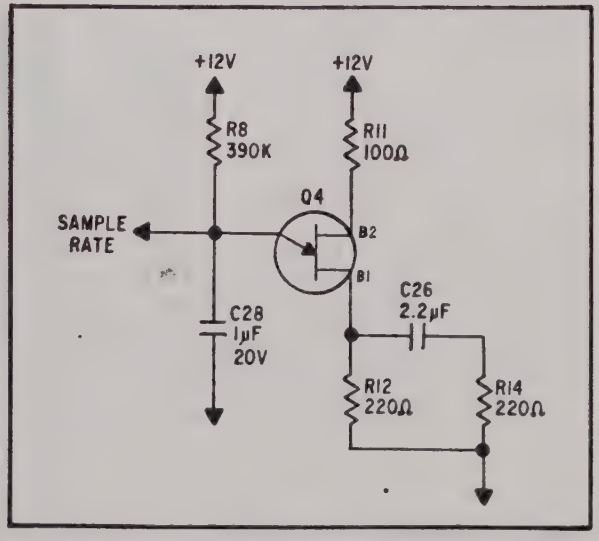


Figure 4-3. Sample Rate Oscillator.

4-18. ANALOG-TO-DIGITAL CONVERTER. The analog-to-digital converter is an integrating voltage to proportional count device that produces an output pulse train. The number of pulses (counts) contained in the output train is an exact function of the unknown input signal voltage. The count output is gated to the input of the counter and latch circuit, the output of which is a parallel digital code. In addition to the count output, the converter also provides a reset command to the counter and latch and accepts a full scale count carry signal from the counter.

4-19. Basically, the conversion technique is a sampling function coupled with dual slope integration; a two-step process. In the first step, the unknown input from the preamplifier is fed through an operational amplifier to an integrating capacitor. The output of this integrator is an increasing voltage with a slope proportional to the input.

4-20. Integration time is controlled by counting 10,000 counts from a clock oscillator. In the second step, the integrator output is driven back to zero. The slope of the decreasing voltage is constant. Therefore, the time is proportional to the unknown input. This time is measured by counting pulses from a clock oscillator. The count is converted to BCD in the counter and latch circuit, stored, and finally displayed as a decimal digit readout.

4-21. The same integrating components and clock oscillator are used in both steps. Any shift in component values caused by temperature drift or aging is self-cancelling. The second step is a direct comparison to the internal reference voltage insuring long-term stability.

4-22. Figure 4-4 is a simplified diagram of the integrating circuit. As can be seen from the figure, the gage factor adjust circuits and normal mode integration circuits are very closely linked. The reason for this is that the coarse and fine resistance settings of the gage factor adjust circuits establish the proper signal damping factor in the normal mode integration circuit according to the rated gage factor of the active strain gage. On the other hand, in order to properly set the gage factor adjust circuits, other suitable integrating circuit values must be established to provide the proper gage factor digital display.

4-23. The integration circuit incorporates th contact groups of the gage factor adjust section of the main multiple pushbutton switch, S1. When the instrument is operating in the normal mode (that is, with either the X1 or X10 push-button depressed), the gage factor adjust section of the multiple pushbutton switch is set as shown in Figure 4-4.

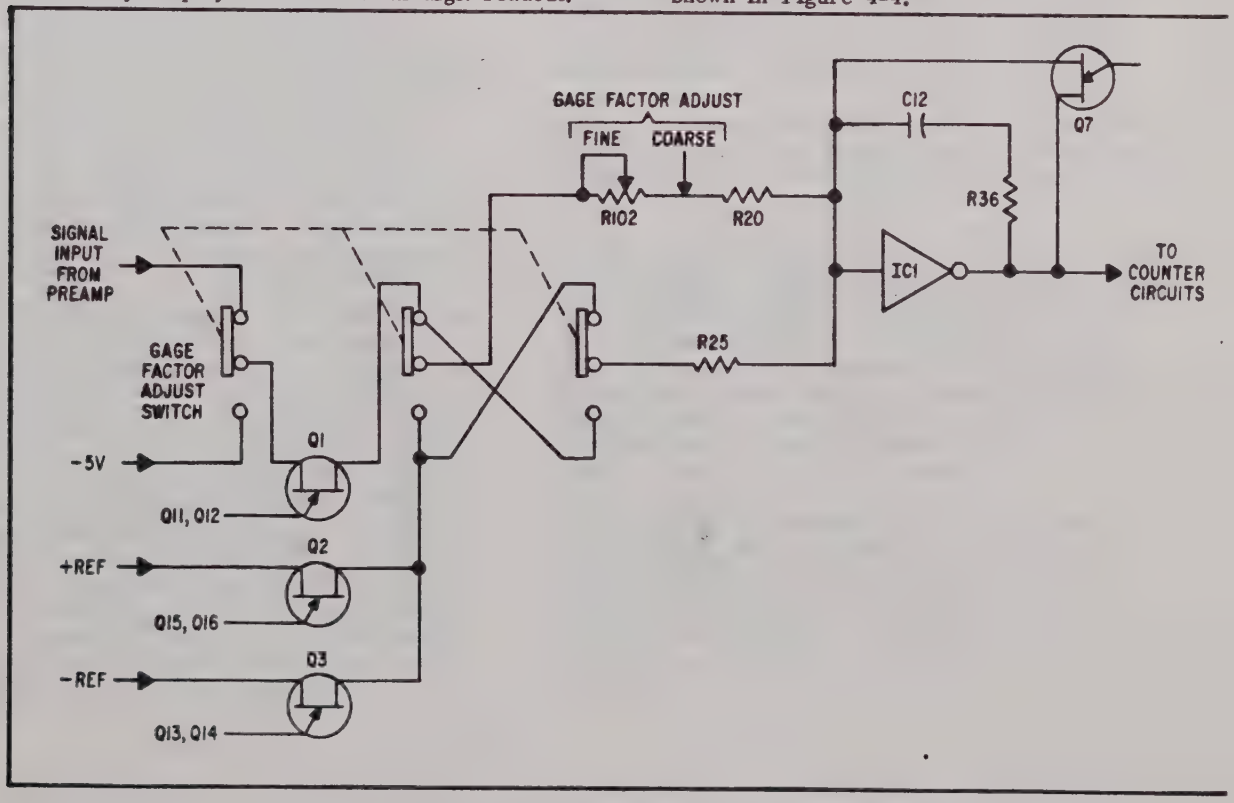


Figure 4-4. Integration Circuit, Normal and Gage Factor Adjust Mode, Amplified Diagram.

4-24. During the up-integration portion of an integration cycle, the preamplifier output signal is applied through one set of switch contacts, through FET switch Q1 which is maintained closed during up-integration, through a second set of switch contacts, then through the gain factor adjust circuit and resistor R20 to charge capacitor C12. During the down-integration portion of the integration cycle, the input signal is cut off by the opening of FET switch Q1 and either FET switch Q2 or Q3 is closed to apply either the +REF or -REF signal to C12 to establish a proper discharge path. If the preamplifier signal is positive, the -REF signal is applied, and vice versa. The other end of the capacitor discharge path is in the counter circuits which enable the drain of uniform voltage increments from C12 via R36 as controlled by the clock pulses. When the capacitor has dropped to zero, the integration count is terminated. At the end of the integration period, FET switch Q7 is closed to insure a zero charge on C12 until the start of the next integration period.

4-25. GAGE FACTOR ADJUSTMENT. When the gage factor adjust section of pushbutton switch S1 is depressed, the gage factor switch contacts shown in Figure 4-4 are moved down and the integration circuit operates as follows. During the up-integration portion of the integration period, a fixed -5 volt signal is applied through the switch contacts, through FET switch Q1 which is closed and through resistor R25 to capacitor C12. During the down-integration portion of the integration period, FET switch Q1 is opened to cut off the -5 volt source and FET switch Q2 is closed to establish the +REF signal as the return path for C12. However, in the gage factor adjust mode, the reference signal applied to C12 is not a constant voltage but rather a variable voltage as determined by the setting of the gage factor adjust controls. This variable reference voltage then becomes the determining factor of the value of the gage factor display.

4-26. COUNTER AND LATCH. The counter and latch circuit is composed of four identical 8-4-2-1 BCD counter circuits, IC14 through IC17, and four identical latch circuits, IC10 through IC13, on the main PC board. The counter for the least significant decimal digit, IC14, receives the serial pulse count from the analog-to-digital converter and divides the frequency by ten. Output from the bit 8 line of IC14 is used to insert the count into the next counter, IC15, and in a similar manner IC15 drives IC16 and IC16 drives IC17. When the serial pulse count has terminated, the BCD coded digits established in the four counters are transferred to the latches which ignore any changes in state of the counters until completion of the next conversion.

4-27. DIGITAL DISPLAY. Latch unit outputs are applied to four BCD-to-seven-line decoders, IC5 through IC8. The internal logic of the decoders translates the BCD inputs to 7-line output signals which are encoded to illuminate the proper digits in the light emitting diodes, LED-1 through LED-5. LED's 2 through 5 provide the four variable digits. LED-1 supplies either a "1" or "0" for the most significant digit as well as the display polarity sign (+ or -). LED-2 also produces the decimal point for the gage factor display when the instrument is operated in the gage factor adjust mode.

4-28. POWER CIRCUIT ANALYSIS.

4-29. General.

4-30. The power supply used with the Model 1200B may be any one of four different types: 1) a selectable 115/230 - volt ac supply; 2) a selectable 100/200 - volt ac supply; 3) a battery pack with a 115/230 - volt ac battery charge circuit; or 4) a battery pack with a 100/200 - volt ac battery charge circuit.

4-31. AC Supplies.

4-32. The 115/230-volt ac power supply and the 100/200-volt ac power supply are identical except for the difference in the primary winding wiring of power transformer T1. Either 115V (100V) or 230V (200V) is applied through fuse F1 and a line filter composed of chokes L1 and L2 and capacitor C13 to the primary of transformer T1. Voltage selector switch S1 selects the primary windings for 115V (100V) or 230V (200V) ac operation.

4-33. Voltage developed on the secondary winding is applied to full-wave bridge rectifier CR6 at pins 7, 8 and 9 and to full-wave center-tapped rectifier CR1, CR2 at pins 10, 11 and 12.

4-34. Rectified voltage at CR6 is regulated at IC1, a positive voltage regulator used with an external pass transistor. This increases output capacity at IC1 and makes available +12V, ±5% at pins J/8 of connector J1. Rectified voltage at CR6 is also applied to precision voltage regulators IC2 and IC3. Regulator IC2 produces a regulated -12-volt output at pins U/17 of connector P1. Regulator IC3 produces a regulated -5-volt output at pins W/19, K/9 of connector P1.

4-35. Voltage developed at pins 10, 11 and 12 of the secondary windings of T1 is applied to rectifier CR1 and CR2. The rectified voltage is regulated by IC4 to produce a positive regulated +5-volt output at pins 6/F, Z/22 of connector P1. An external pass transistor is also used with IC4 for external current output capacity.

4-36. Battery Packs.

4-37. The rechargeable battery packs are completely interchangeable with the ac power supplies without modification. A battery pack consists of eight 1.2V rechargeable nickel cadmium batteries. One battery pack is equipped with a 115V or 230V ac battery recharger power supply. The other battery pack is equipped with a 100V or 200V ac battery recharger power supply. Four batteries form a +4.8V supply for the digital logic supply and four form a -4.8V supply for strain gage bridge power. A dc-to-dc converter operating from the ±4.8V supplies produces a ±12V supply for analog circuits.

4-38. The battery saver circuit increases the working life of the batteries which are rated for one hour continuous duty. When the DISPLAY switch is in ON position, and the READ switch is set to MOM, capacitor C4 is charged to +4.5-vol and transistor Q1 conducts. This energizes the relay, K1, which switches on the instrument. The length of time the instrument stays on is a function of the value of C4 and the resistance setting of the DISPLAY TIME potentiometer.

SECTION V
MAINTENANCE

5-1. INTRODUCTION

5-2. General.

5-3. This section provides the information and outlines the procedures necessary for the proper maintenance and service of the Model 1200B Digital Strain Indicator. Information includes preventive maintenance, troubleshooting, repair and replacement and calibration.

5-4. Test equipment recommended for checking and troubleshooting the instrument is listed in Table 5-1. Test instruments other than those listed in the table can be used providing the performance equals or exceeds the required specifications.

5-5. Chassis Disassembly.

5-6. The front cover of the indicator is easily removed by lifting the latches located on the sides of the case as shown in Figure 5-1. A simplified instruction card showing typical gage hookups and instrument operation is mounted inside the front cover.

5-7. The chassis must be removed from the case for the replacement or installation of printed circuit boards and individual components and for access to test points and internal controls. The locations of components, test points and internal controls are shown in Figures 5-4 through 5-8. To remove the chassis, proceed as follows (see Figure 5-2).

Table 5-1. Recommended Test Equipment

TYPE	CHARACTERISTICS	USE	RECOMMENDED
Calibrator	Output accuracy at each point 0.1% or ±0.0003mV/V whichever is greater.	Troubleshooting, Calibration	BLH Model 625 Precision Calibrator
AC/DC VTVM	1mV to 100V, 10 megohm impedance.	Troubleshooting, Adjustment	
Decade Resistor	Total resistance, 10,000 ohms multiple of 1 ohm 0.05% accuracy.	Troubleshooting	
Multimeter	1% accuracy at full scale input impedance 100 megohms	Troubleshooting	Hewlett Packard Model 414A
Oscilloscope	200kHz bandwidth	Calibration, Troubleshooting	
Variable Power Transformer	0-230Vac	Troubleshooting	VARIAC
Standard Dead Weights	Class C or better - capacity to suit system.	Calibration	

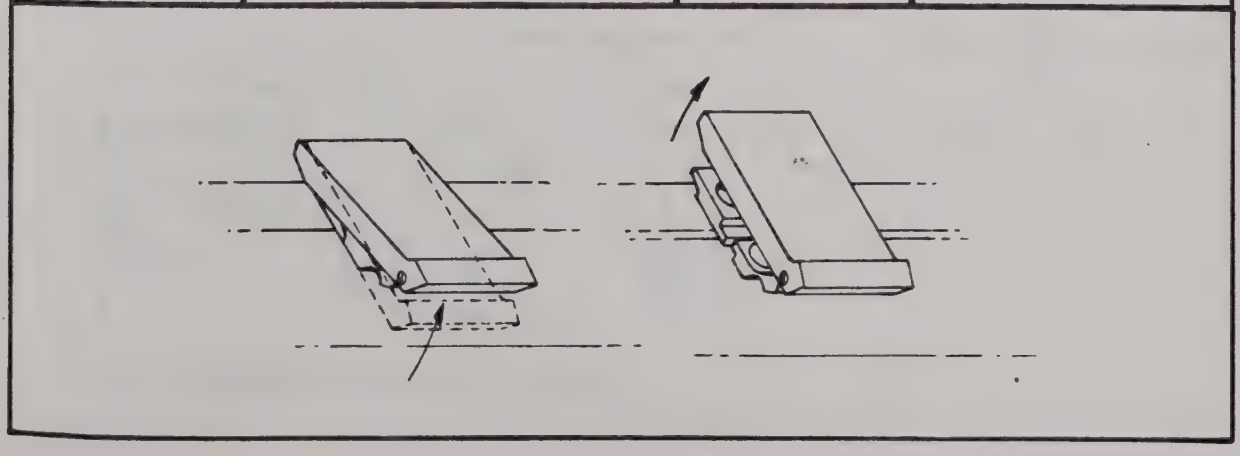


Figure 5-1. Cover Removal.

a. Unplug the instrument and unlatch and remove the front cover.

b. Locate and remove the two 6-32 X 3/8 rear panel power supply retaining screws.

c. Withdraw the power supply by pulling it directly to the rear as shown. If the power supply does not move out easily, rock it gently from side to side while pulling rearward.

d. Remove four Phillips-head front panel retaining screws located two on the top side and two on the bottom side at the front end of the cover assembly.

e. Remove the four rear panel chassis retaining screws exposed after the power supply has been removed.

f. If the instrument is equipped wi the BCD output option, remove two screws which secure the BC connector to the rear panel to release the connector from the

g. Grasp the front panel and remov the chassis from the cover asse

5-8. To check test points and make adjus place the front panel/chassis assembly on an insulated surface and plug in the power supply through an extender board. (See inset, Figure 5-2.)

5-9. If, as a result of testing or trouble-shooting, the decision is made to remove any of the three plug-in printed circuit boards (ma PC board, A/D converter PC board, or LED display PC board) the boards must be disassen from the front panel/chassis assembly as follows (see Figure 5-3).

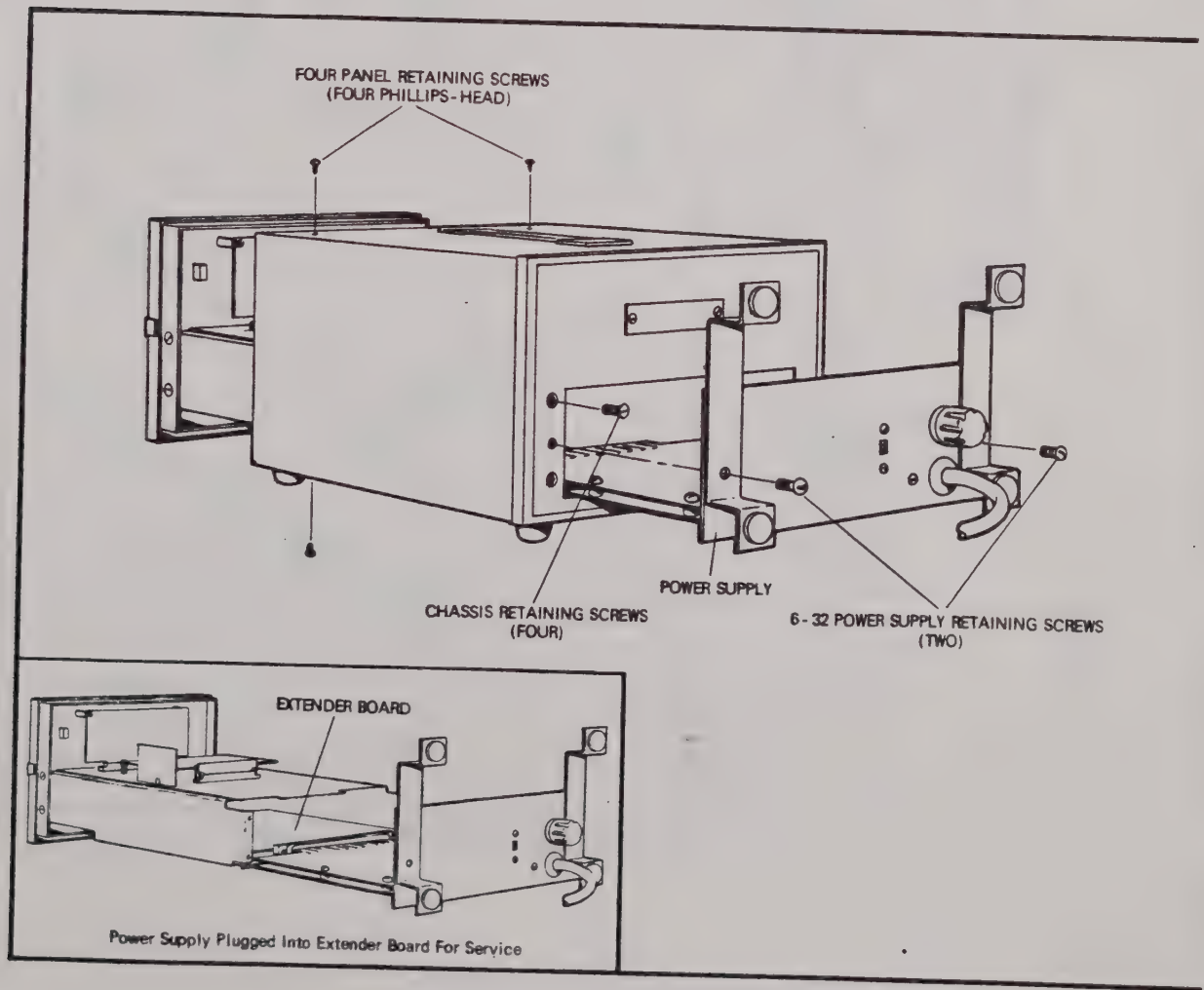


Figure 5-2. Chassis Removal.

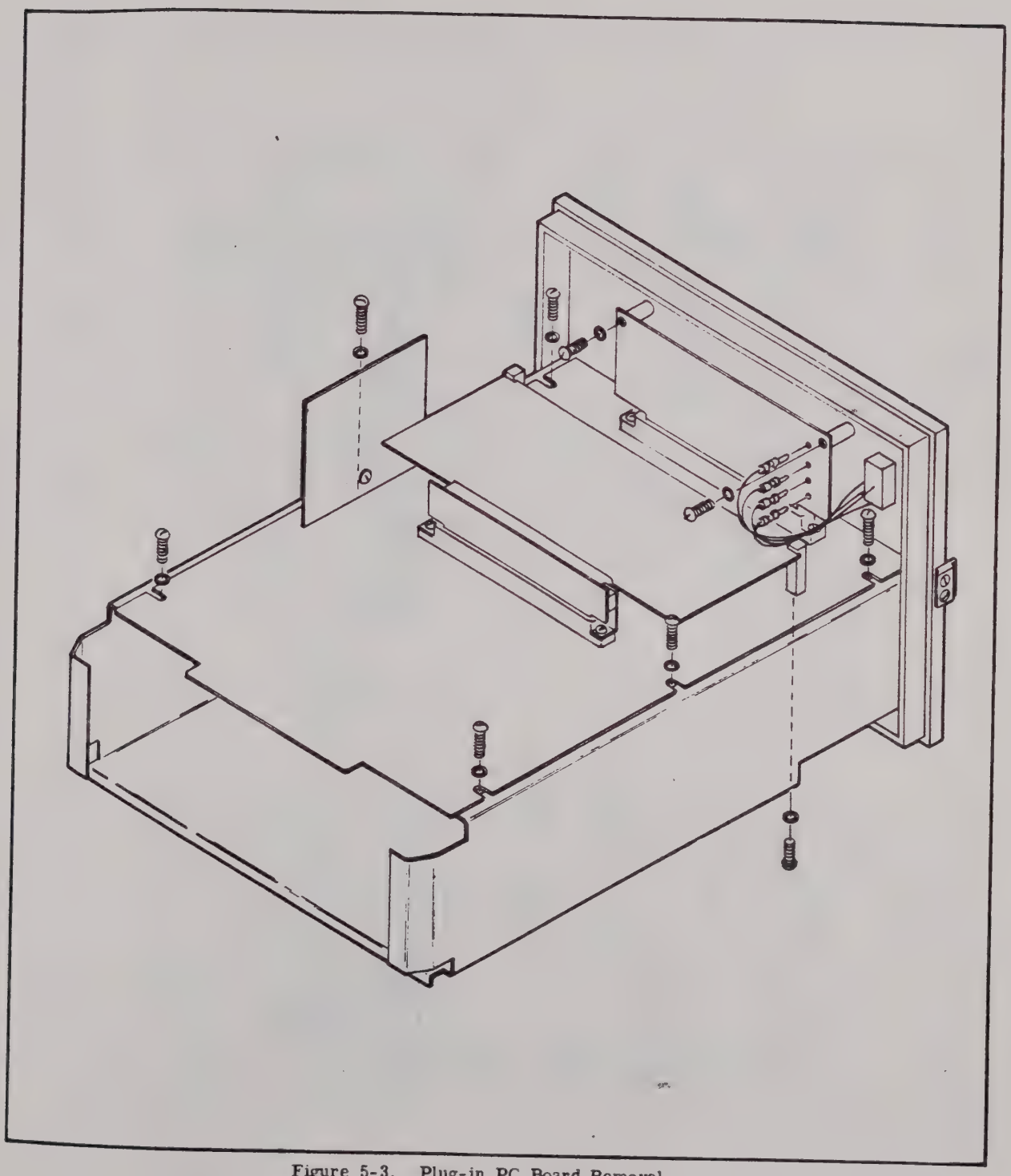


Figure 5-3. Plug-in PC Board Removal.

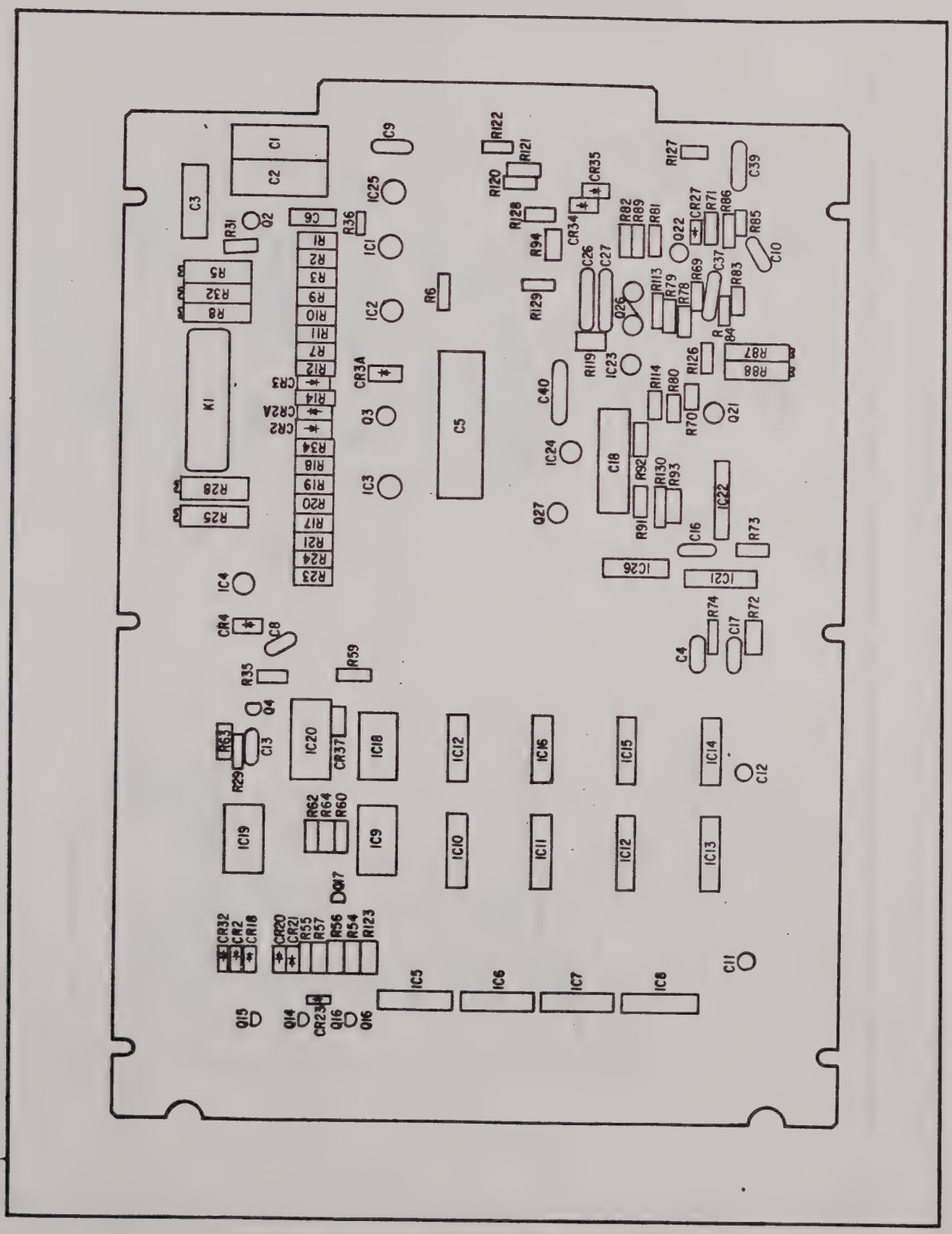
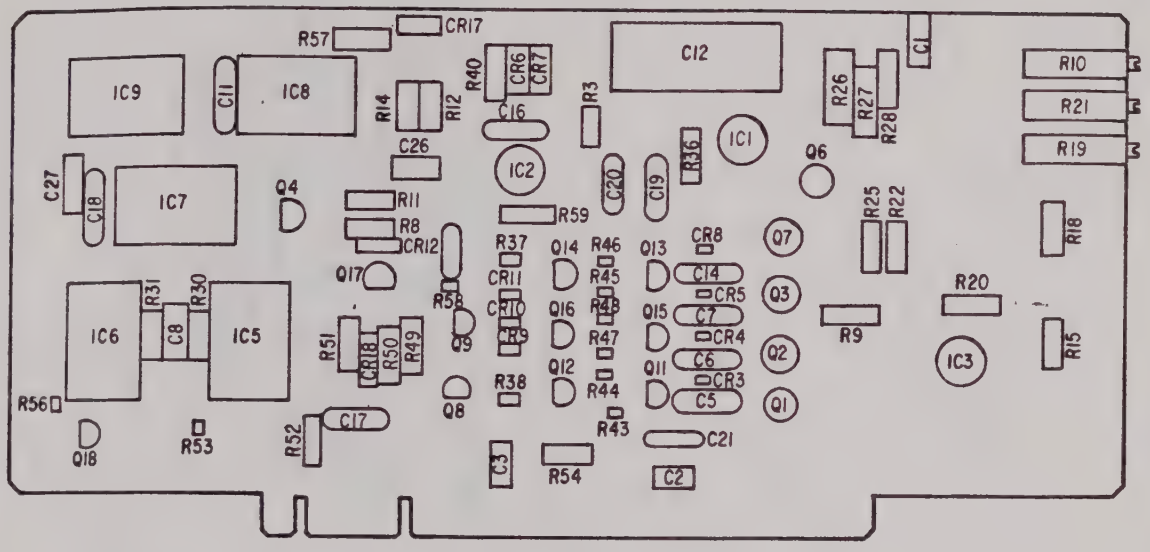


Figure 5-4. Component Location, Main Circuit Board



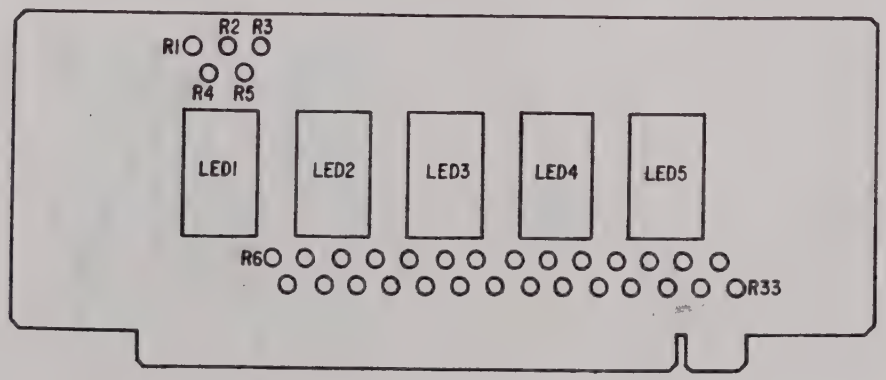
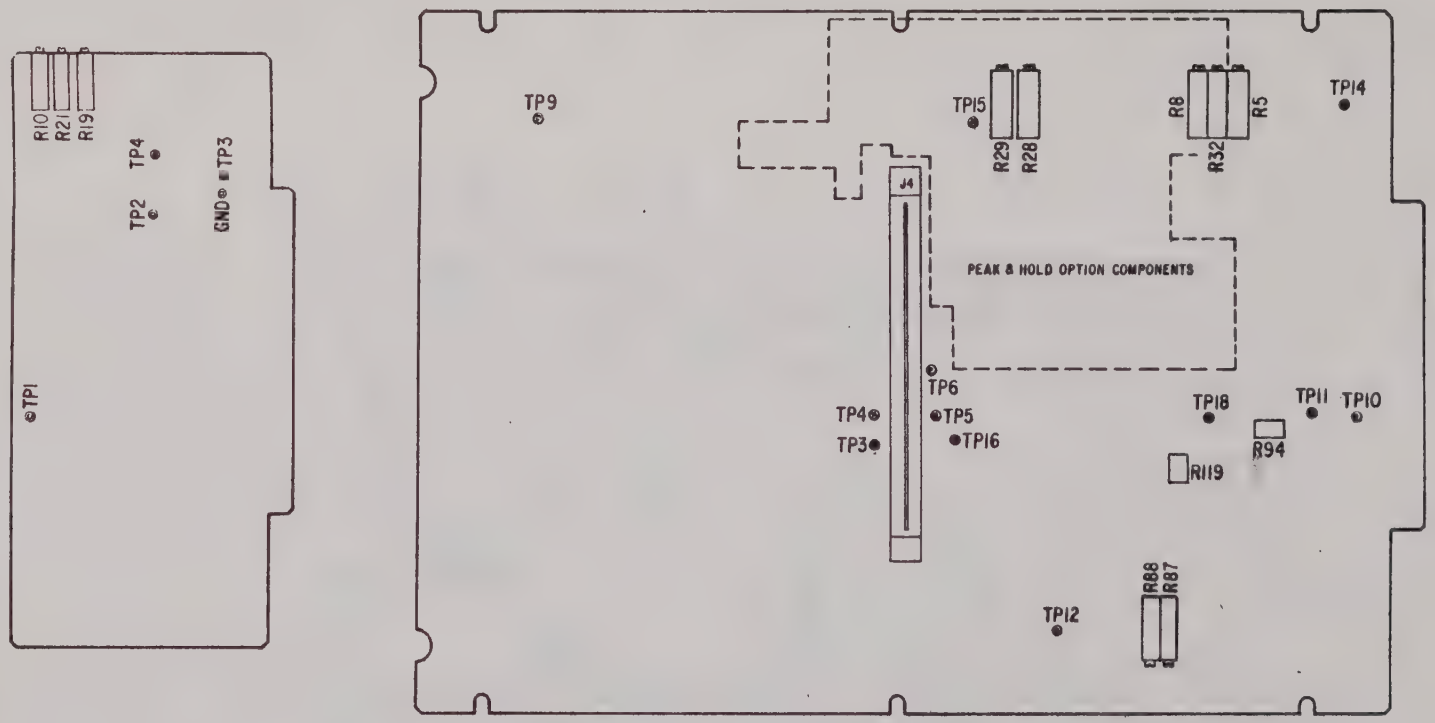


Figure 5-5. Component Location, A/D Converter and Display Boards



R5	Reference Amplifier Zero Adjust Control	TP2*	Negative Reference Test Point
R8**	Gain Adjust Control	TP3*	Positive Reference Test Point
R10*	Integrator Zero Adjust Control	TP3	External Trigger Test Point
R19*	Positive Reference Adjust Control	TP4	Full Scale Count Test Point
R21*	Reference Amplifier Zero Adjust Control	TP4*	Reference Amplifier Zero Test Point
R25**	Amplifier Stage 3 Zero-Adjust Control	TP5	Clock Out Test Point
R29**	Amplifier Stage 2 Zero Adjust Control	TP9	Inhibit Pulse Test Point
R32**	Amplifier Stage 1 Zero Adjust Control	TP11	Preamplifier in Test Point
R87	X1 Gain Adjust Control	TP12	Preamplifier Out Test Point
R88	X10 Gain Adjust Control	TP14	Filter Out Test Point
R94	Auto Zero Offset Adjust Control	TP15	+12 Volt Test Point
R119	Dynamic Zero Adjust Control	TP15**	Peak and Hold Out Test Point
TP1*	+5 Volt Test Point	TP18	-12 Volt Test Point

* This control or test point located on the A/D Converter PC Board.
** This control or test point part of the Peak and Hold Circuit (Option 05).

Figure 5-6. Control and Test Point Locations

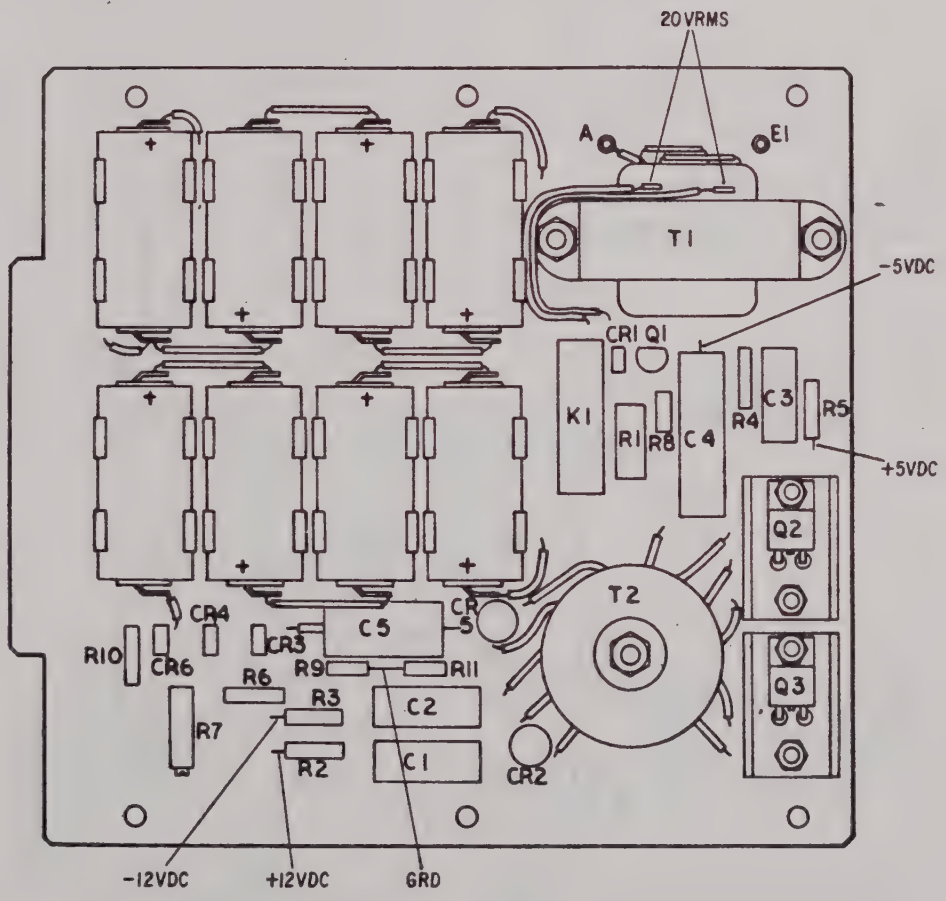


Figure 5-7. Control Location, Battery Power Supply Board

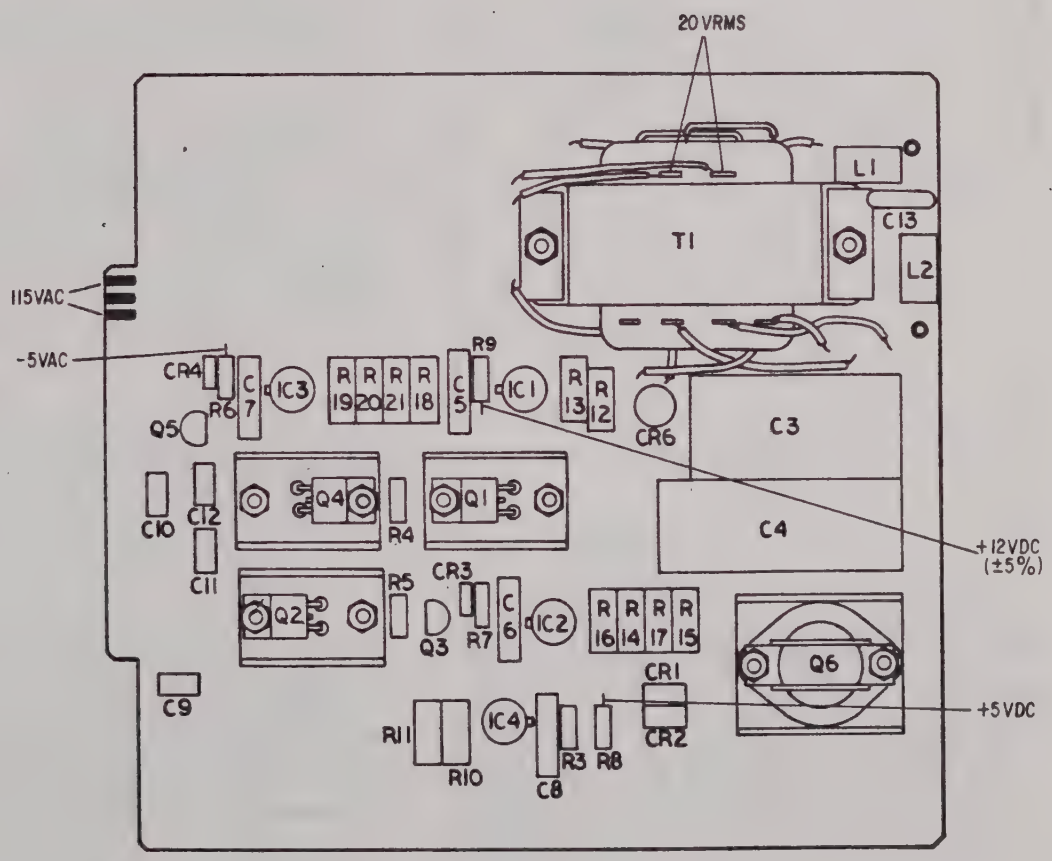


Figure 5-8. Component Location, A/C Power Supply Board

a. Disconnect the four pin-connector leads at the rear of the LED display board.

b. Remove the two screws which secure the LED display board to the front panel.

c. Remove the six screws which secure the main PC board to the chassis frame. Remove the main PC board from the chassis frame.

d. To remove the LED display PC board from the main PC board simply unplug the LED display PC board from its connector.

e. To remove the A/D converter PC board from the main PC board, first remove the two A/D converter PC board support posts by removing the two screws from the bottom side of the main PC board which secure the posts. After that, unplug the board from its connector.

5-10. PREVENTIVE MAINTENANCE

5-11. Cleaning.

5-12. The Indicator is enclosed in a vinyl-coated aluminum cabinet and should be cleaned only with a damp cloth moistened in a solution of warm water and mild detergent. Do not use any chemical solvents or abrasive cleaners on the vinyl case or anodized aluminum surfaces. Use a soft brush remove external dust accumulation.

5-13. Loose dust within the chassis can be removed with dry, low-pressure compressed air or a small vacuum cleaner. Contamination of the switches, circuit boards, or edge connectors will cause high impedance leakage paths and subsequent deterioration of instrument performance. Avoid touching any of these circuits with the bare fingers as skin oils are extremely contaminating.

5-14. Do not use a pencil to trace circuits in the instrument. Graphite pencil lead is an excellent conductor and an accidentally introduced path of this type is often difficult to locate. If printed circuits do become contaminated during trouble-shooting or replacement, clean with a weak solution of warm water and mild detergent. Rinse thoroughly with clean water and allow to dry completely before operating. Do not use alcohol or any other cleaning solution except detergent and water. PC board edge connections can be cleaned with a fiberglass brush, if available, or with an ordinary pencil eraser as indicated in Figure 5-9.

CAUTION

DO NOT USE COMMERCIAL MOISTURE SEALING SPRAYS ON THE BOARDS. APPLICATION OF THESE AGENTS WILL CAUSE LEAKAGE PATHS AND SUBSEQUENT DETERIORATION OF INSTRUMENT PERFORMANCE.

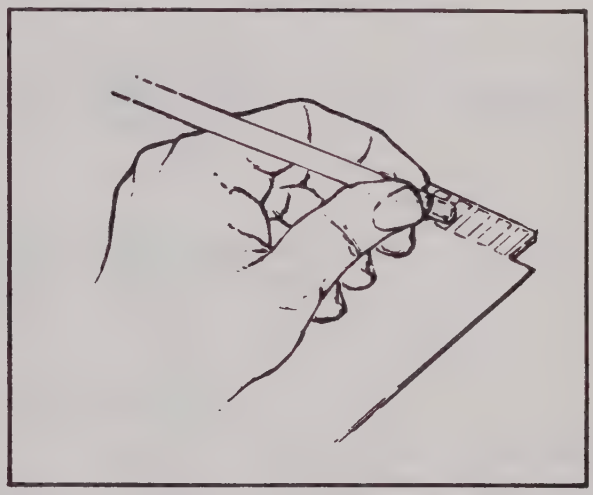


Figure 5-9. Cleaning PC Board Edge Connectors.

5-15. Lubrication.

5-16. Each pushbutton module has been lubricated during assembly and does not require further lubrication during normal operation. During continuous operation in extremely dusty environments, however, an occasional application of a commercial spray cleaner such as Miller-Stephenson MS-230 Contact RE-NU to both the pushbutton and rotary switches will clear the contacts of possible contamination. When lubricating the pushbutton switches, apply the cleaner/lubricator through an extension nozzle at the rear of the switch stator block as shown in Figure 5-10.

5-17. Periodic Check.

5-18. BLH recommends that the instrument be performance tested on a quarterly basis (500 hours) if possible. During extended tests, where 24 hour operation is common, performance test the instrument during scheduled maintenance/cleaning downtimes or whenever possible. The calibration check in Section II provides a valid check of instrument performance that can be performed without disrupting normal test system operation.

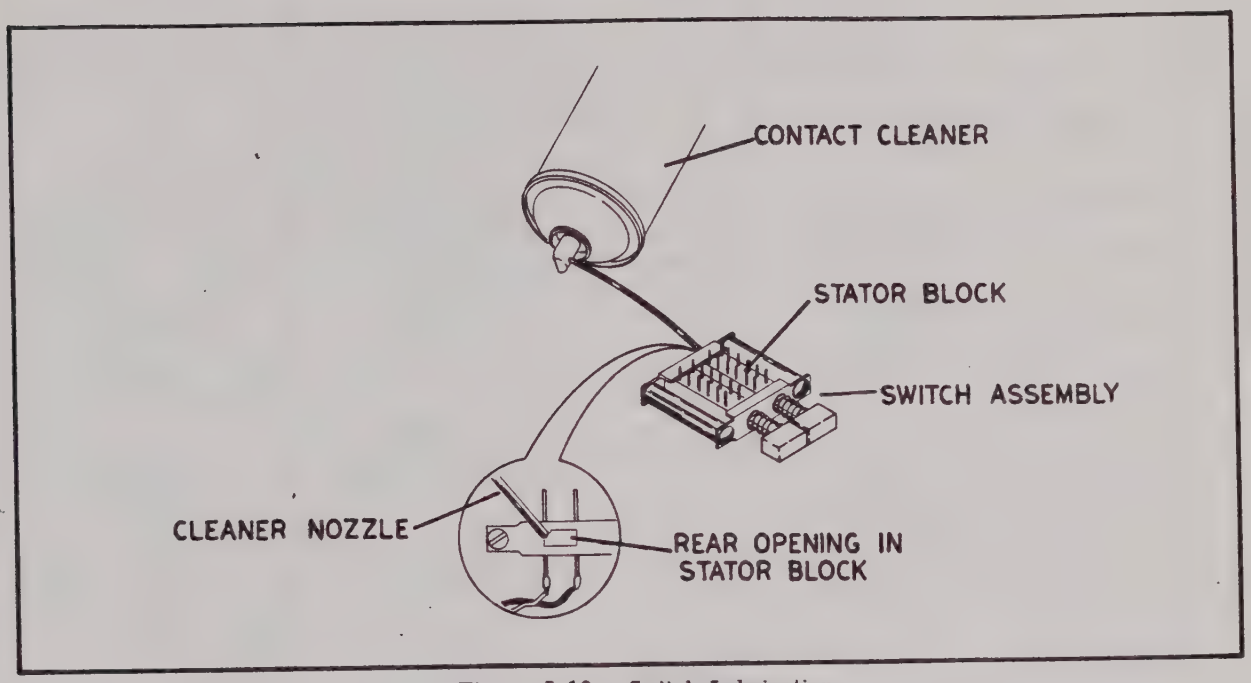


Figure 5-10. Switch Lubrication.

5-19. The instrument can be returned to BLH for a thorough overhaul whenever necessary and checked with test instruments traceable to the National Bureau of Standards. If user maintenance and calibration is not feasible, or if unusual problems or applications are encountered, a visit by a BLH Field Service Engineer can be arranged by contacting the main office Field Service Division.

5-20. FACTORY SERVICE. If factory service is required, the instrument must be accompanied by the RETURN AUTHORIZATION FORM 862. Upon examination of the instrument at the factory, a full report on the instrument condition along with a quotation on repair cost (if not under warranty) and delivery time will be submitted to the customer before work is begun.

5-21. TROUBLESHOOTING.

5-22. Preliminary.

5-23. The troubleshooting techniques discussed in the following paragraphs apply to both the AC and BAT operated instruments. The basic tools for troubleshooting are the schematic diagram at the rear of the manual, the theory information in Section IV, and the Troubleshooting Aid, Table 5-2, in this section. The most effective method of troubleshooting is to sectionalize the malfunction to a specific unit before attempting to localize the problem to a particular circuit or stage.

5-24. Table 5-2 contains a summary of front panel symptoms that usually indicate the malfunction of a specific component or board; check before continuing troubleshooting process. Test point locations are illustrated and listed in Figure 5-6. Use of the extender board, P/N 417298-2, as shown in Figure 5-2, facilitates troubleshooting the power supplies.

CAUTION

WHEN INSPECTING BOARDS DO NOT TOUCH EDGE CONNECTORS OR THE ETCHED CIRCUIT TRACE. DO NOT TRACE SIGNAL PATHS OR TEST COMPONENTS FOR LOOSENESS WITH A PENCIL AS IT IS POSSIBLE TO INTRODUCE HIGH IMPEDANCE LEAKAGE PATHS WITH GRAPHITE.

5-25. SUBSTITUTION. Troubleshooting is greatly simplified if checking is done by replacing an assembly suspected of malfunction with a spare unit known to be operating correctly. Where the malfunctioning assembly is found, the faulty component can be replaced if practicable or the entire assembly shipped to a BLH Sales/Service Office for repair or replacement.

Table 5-2. Troubleshooting Aid

SYMPTOM	PROBABLE CAUSE	REMEDY
Blank (unlighted) display.	Power supply. Fuse F1, line switch, power transformer, dead batteries.	Replace defective components or power supply.
Display drifts.	Auto-zero circuit.	Replace circuit board.
Saturated display in excess of overrange.	Defective cabling. Signal input or signal circuit open.	Check signal circuit.
Display indicates 00000 (no gain)	Shorted signal input.	Check signal input circuitry and gages.
Individual digits displayed erratically.	Decoder.	Replace defective decoder.
Improper tracking (poor linearity)	Gages preamplifier.	Replace gages w/625 Calibrator; if condition remains, replace circuit board.
Intermittent or erratic operation.	Contaminated edge connectors.	Clean boards (Figure 5-9).

Table 5-3. Conversion Table

CONVERSION TABLE - MICROINCHES-PER-INCH TO MILLIVOLTS-PER-VOLT					
μ INCHES	Mv/V	μ INCHES	Mv/V	μ INCHES	Mv/V
0	0	1400	.70	4000	2.00
100	.05	1500	.75	4500	2.25
200	.10	1600	.80	5000	2.50
300	.15	1800	.90	5500	2.75
400	.20	2000	1.00	6000	3.00
500	.25	2200	1.10	6500	3.25
600	.30	2400	1.20	7000	3.50
700	.35	2500	1.25	7500	3.75
800	.40	2600	1.30	8000	4.00
900	.45	2800	1.40	8500	4.25
1000	.50	3000	1.50	9000	4.50
1200	.60	3500	1.75	9500	4.75
				10 000	5.00

See p. 2-10 for applicable conditions of GF, no. of active arms.

5-26. External Circuit.

5-27. Substitution of a BLH Model 625 Calibrator for the gages (Figure 5-11) at the front panel of the indicator will sectionalize the trouble to the gages, cabling and connections, or indicator. Set the calibrator to the output required and check indicator readout (1 mV/V = 2000 microinches per inch. See Table 5-3, Conversion Table Micro-inches Per Inch to MV/V). If the indicator output is correct for the range and step selected, the trouble lies with the external (strain gages) circuit.

5-28. Inspect length of cable or gage leads for breaks, cuts, or bruises. Check cable continuity in a weighing situation by moving the cable at the connector and by bending the cable in short loops while an observer monitors the indicator. If indicator readings are erratic or intermittent, replace entire cable assembly or lead. If the gages appear to be faulty, refer to the data supplied with the gages for troubleshooting.

5-29. Power Circuit.

5-30. UNLIT DISPLAY. (If display is lit, see paragraph 5-36). If the display is unlit, begin with the power source and power cable. Check that instrument is plugged in and that power source voltage is reaching the receptacle; check power cord for breaks, cuts, and bruises. If power cord is intact, check fuse F1. If F1 is blown, carefully inspect the electrical connections in the system for shorts before replacing with a 1/4 ampere AGC fuse (BLH P/N 238588-8). Check power switch S1 by shorting the terminals with a test lead jumper.

5-31. Transformer T1 can be checked in the instrument. Measure voltage at the secondary windings with line power applied to the primaries If the voltage is approximately 20VRMS and there are no primary-to-secondary short circuits, the trouble should be confined to the power supply bo

5-32. If malfunction is not listed in Table 5-2, disconnect the gages and substitute a known signa input, e. g., 625 Calibrator. Plug the instrumen into a variable power transformer (Variac) and gradually lower the power input voltage to the low specified operating limit (103V for 115V instrume This procedure will often cause marginal assembl to fail completely or to indicate a malfunction lis in Table 5-2.

5-33. If the previous procedures are not effective, attempt to localize the malfunction by substitution (paragraph 5-25). Once identified as faulty, inspect the board for obvious, easily repairable, defects such as loose components or foil breaks. It is sometimes possible to determine a faulty IC by close inspection or by substitution. Carefully inspect the gold plating on the IC leads. They must show no peeling or blistering and there must be no evidence of corrosion on the body of the lead.

5-34. If the general appearance is satisfactory, protect the board and component from heat damag and swap the suspected IC for another of the sam type. Check performance. If different conditions or symptoms are reversed (superimposed digits to next tube when drivers are switched) replace if available or order new IC.

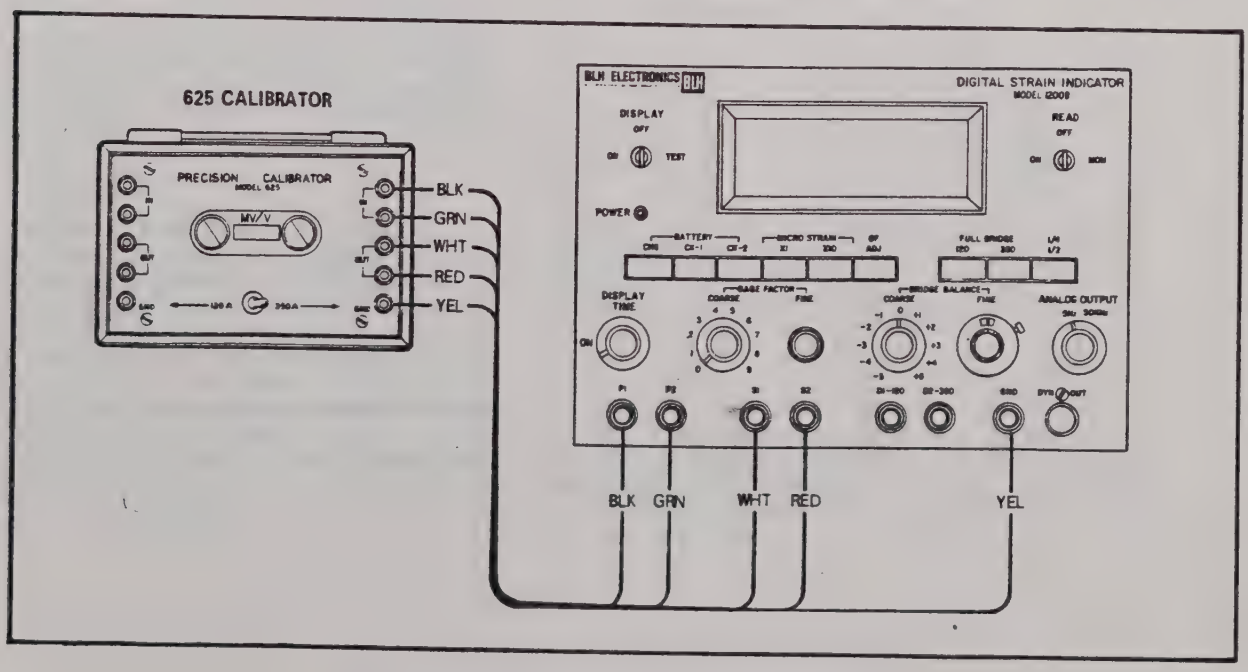


Figure 5-11. 625 Calibrator Connections.

5-35. If voltages are out of spec or non-existent, push in firmly on the board and recheck the voltages. If results are negative, give the board a thorough visual inspection. Look for loose components or similar conditions which would indicate a trouble source. If no obvious fault is indicated during the visual inspection, replace the board as a unit. See paragraph 5-48 before repairing any printed circuit board.

5-36. LIT DISPLAY. (The following also applies to unlit display after proceeding through paragraphs 5-35.) If the display is lit, the power circuit through transformer T1 can be eliminated as a potential trouble source. Check the 5 and 12V circuits on the power supply boards and the test points indicated in Figure 5-7 and 5-8. All dc voltages should be regulated and within ±5% of the listed value over the specified live operating power of the instrument.

5-37. Signal Circuit.

5-38. Generally, a malfunctioning signal circuit component, (preamplifier, converter, counter and latch and digital display) can be identified by one or more of the symptoms listed in Table 5-2. A thorough understanding of the operation and function of each circuit (see Section IV) will help in diagnosing malfunctions not immediately apparent from front panel indications.

5-39. REPAIR AND REPLACEMENT.

5-40 Field Replaceable Items.

5-41. Some of the items listed in the following paragraphs are recommended for field replacement only in emergencies. With the exception of easily repairable defects, (foil breaks, single components etc.) it is usually more economical to return the entire instrument to the factory for repair and recalibration than to attempt extensive repairs.

5-42. Main Chassis.

5-43. PLUG-IN BOARD REPLACEMENT*. There are three plug-in boards in the main chassis - the main plug-in board and the A/D converter and LED display plug-in boards which plug into the main board. Unless the repair to a plug-in board is a minor mechanical one, the entire board should be replaced as a unit. It is unusual for a single component to fail without affecting others and most massive failures are the result of extreme environmental conditions affecting the entire instrument. If the board must be replaced in the field, remove it following the disassembly procedures given in paragraphs 5-5 through 5-9.

IMPORTANT

If a main plug-in board has been replaced, the instrument must be recalibrated after the replacement board has been installed.

5-44. IC REPLACEMENT. Three types of IC packages are used in the Model 1200: plug-in TO-116 flatpacks, soldered-in TO-116 flatpacks and soldered-in TO-99 packs. Do not attempt to replace the soldered-in type of IC unless shaped soldering irons are available and work is assigned to technicians familiar with replacement of these components.

5-45. Plug-in ICs should be removed with a commercially available extractor tool (Augat /T114-1 - see Figure 5-12). If a commercial extractor tool is not available, a substitute can be easily fabricated from a piece of scrap aluminum or steel.

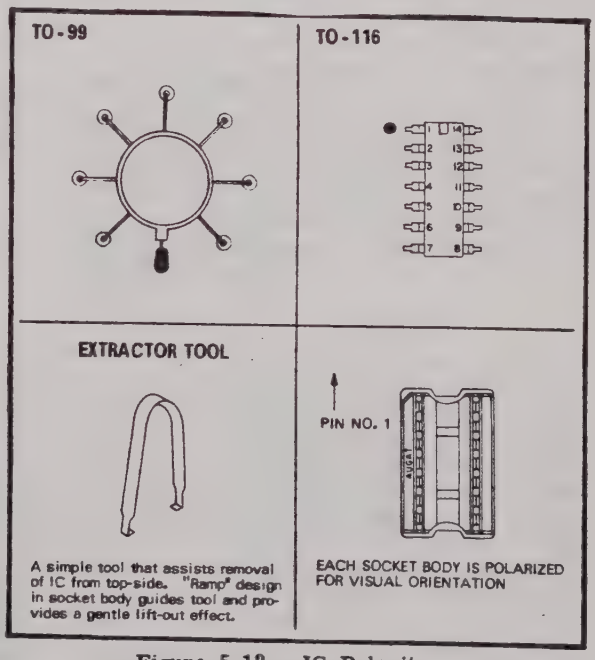

TO-99
TO-116
EXTRACTOR TOOL
PIN NO. 1
A simple tool that assists removal of IC from top-side. "Ramp" design in socket body guides tool and provides a gentle lift-out effect.
EACH SOCKET BODY IS POLARIZED FOR VISUAL ORIENTATION

Figure 5-12. IC Polarity.

5-46. When removing plug-in ICs, disconnect power from instrument if PC board is not removed and grasp ends of module with tool or fingers and draw steadily upward until leads are free of socket. Do not bend leads.

5-47. Before replacing an IC, either plug-in or soldered-in type, check for proper alignment and polarity. For plug-in types, the notch or depression in the end of the flatpack body must be positioned toward the socket end with the beveled corner. Line up replacement IC with socket holes, set lightly into place and level carefully. Place thumb squarely on IC and press into place.

5-48. For soldered-in types of flatpacks, position the notched end toward the etched dot on the board. The dot signifies pin #1 of the circuit. On TO-99 packs, pin #8 is directly beneath the tab on the body of the IC. Align the tab over the elongated pad on the PC board.

5-49. TRANSISTOR REPLACEMENT. Transistors are inherently long-lived devices and should be replaced only when indicated as faulty. Do not check soldered-in transistors by substitution as the transistor or circuit board may be damaged. Leakage current from the soldering iron or a momentary short can permanently damage a transistor.

5-50. Refer to paragraph 5-42 before attempting to replace a transistor, then use a hot 50 watt or smaller iron. Apply heat to the leads of part to be replaced, NOT to the printed circuit on the board. Clean holes before installing the new transistor. Use long-nose pliers as a heat sink between the iron and transistor. Allow the transistor to cool before applying power to the unit.

5-51. SERVICING ETCHED CIRCUIT BOARD Excessive heat or pressure can lift the copper strip from the board. Avoid damage by using a low-power soldering iron (50 watts maximum) and following these instructions. Copper that lifts off the board should be cemented in place with a quick-drying acetate base cement having good electrical insulating properties. A break in the copper should be repaired by soldering a short length of tinned copper wire across the break. Use only high quality rosin core solder when repairing etched circuit boards. NEVER USE PASTE FLUX. After soldering, clean off any excess flux and coat the repaired area with a high quality electrical varnish or lacquer. When replacing components with multiple mounting pins such as transistors, electrolytic capacitors, and potentiometers, it will be necessary to lift each pin slightly, working around the component several times until it is free.

a. Apply heat sparingly to lead of component to be removed. If lead passes through an eyelet in the circuit board, apply heat on the component side. If lead does not pass through an eyelet, apply heat on the conductor side of board.

b. Reheat solder in vacant eyelet and quickly insert a wood sliver or toothpick to clean inside of hole.

c. Bend clean tinned leads on new component and carefully insert through eyelets or holes on board.

d. Hold part against board (avoid overheating) and solder leads. Apply heat to component leads on correct side of board as explained in step "a" above.

e. If the steps above are impractical or the board has been damaged, clip the leads of the component to be removed close to the part itself leaving as long leads as possible still soldered to the board.

f. Straighten old leads and bend leads of new part around the protruding leads. Apply solder using a pair of long-nose pliers for a heat sink.

5-52. Front Panel Assembly Components.

5-53. All front panel controls are fastened to the front panel with a combination of lock washers, nuts and machine screws. Replacement of front panel components requires that the front panel be sufficiently separated from the chassis frame so that the wire leads at the controls can be soldered without difficulty.

CAUTION

IF THERE IS ANY ATTEMPT TO REPLACE A FRONT PANEL CONTROL, SPECIAL CARE MUST BE TAKEN TO PROPERLY LABEL ALL LEADS WHICH MUST BE UNSOLDERED FROM THE CONTROL BEFORE REMOVAL TO ENSURE THAT THEY ARE PROPERLY RE-SOLDERED AFTER REMOUNTING.

To properly release the front panel, proceed as follows:

a. Perform the chassis disassembly as described in paragraphs 5-5 through 5-9.

b. Remove the two screws on the side of the chassis frame which hold the two cable clamps for the wire harness to the main PC board connector J2, to the chassis frame. Also remove nut and bolt which are used to secure the ground leads for that wire harness to the chassis frame.

c. Remove the four screws, two on each side, on the front panel which secure the front panel to the chassis frame.

d. Separate the front panel sufficiently from the chassis frame to gain access to the leads soldered to the front panel controls.

5-54. For assistance in mounting and dismounting front panel controls, refer to Figures 5-13 and 5-14. Note that the pushbutton switch assembly includes a printed circuit board and the same precautions should be taken for handling this assembly as for handling any printed circuit board (see paragraph 5-51).

5-55. The POWER indicator lamp, D51 is cemented in place with glyptol. To remove the lamp, first pad its face with cardboard or a small square of foam rubber, then knock it through the rear of the front panel with a 1/8 inch punch. To cement the replacement in place, use Monsanto Electronic Special Product #mV10B.

5-56. Power Supplies.

5-57. BATTERY REPLACEMENT. Battery operated instruments are powered by eight 1.2V rechargeable nickel cadmium size RR dry cells. Four batteries form a +4.8V supply for the digital logic. The remain four form a -4.8V bridge power supply. The combined outputs of the eight batteries are used to power a 12 volt regulator circuit which provides ±12V operating power for the analog circuits. The level of charge in the batteries is indicated on the digital display when the BATTERY CHK 1 or the BATTERY CHK 2 switch is depressed. A reading below 4100 indicates that the batteries should be recharged. If, after 24 hours on charge, the battery check readout cannot be raised above 4100, replace the batteries as follows (see Figure 2):

a. Unplug the instrument and unlatch and remove the front cover.

b. Locate and remove the two 6-32 X3/8 rear panel power supply retaining screws.

c. Withdraw the power supply by pulling it directly to the rear as shown. If the power supply does not move out easily, rock it gently from side to side while pulling rearward.

d. Snap the batteries upward out of the clips. When replacing, observe the polarity indicator etched on the surface of the board. Replace with Gulton R125, size RR (BLH #138542-8).

5-58. POWER CORD REPLACEMENT. Both the battery and ac operated instruments are equipped with an eight-foot, three conductor power cable. When replacing, note lead connection points. The green lead is the ground lead and must be connected to the case. Removal and replacement of the power cable require that the power supply be removed.

a. Compress strain relief inside case with special tool if available, or with pliers, and push out of mounting hole.

b. Prepare new cable for installation (tin wires, etc.).

c. Thread new cable through strain relief and reinstall in power supply chassis. Leave approximately two inches of sheathed cable inside case in addition to six inches of stripped, tinned leads.

d. Press strain relief into mounting hold to secure.

e. Solder new cable to proper connection points.

5-59. TRANSFORMER REPLACEMENT. Transformers T1 and T2 can be removed without removing the power supply etched circuit board. Before removing, tag each lead - both primary and secondary - with the corresponding transformer coil lead identification number. When unsoldering, protect nearby components and etched circuit board from heat damage (see paragraph 5-39).

5-60. FUSE REPLACEMENT. Electrically, the entire instrument forward of the input side of the line filter is protected by a 1/4A, 250V fuse. The fuse (F1) is the only one in the instrument and is physically located in a fuse holder on the lower rear panel of the power supply. Replace with BLH #128588-8 (Buss, AGC 1/4) after first determining and rectifying cause of overload.

5-61. CALIBRATION

5-62. General.

5-63. The indicator measuring circuits contain both fixed and high-stability, precision wire-wound resistors, and solid-state components operated well below their maximum ratings. Once adjusted at the factory, the Indicator seldom requires recalibration. The following procedure is not recommended for routine or incoming quality control checks. Use the procedure outlined in Figure 2-11 for those checks.

5-64. If, however, a component fails and is replaced, or if the accuracy of the Indicator is in doubt for

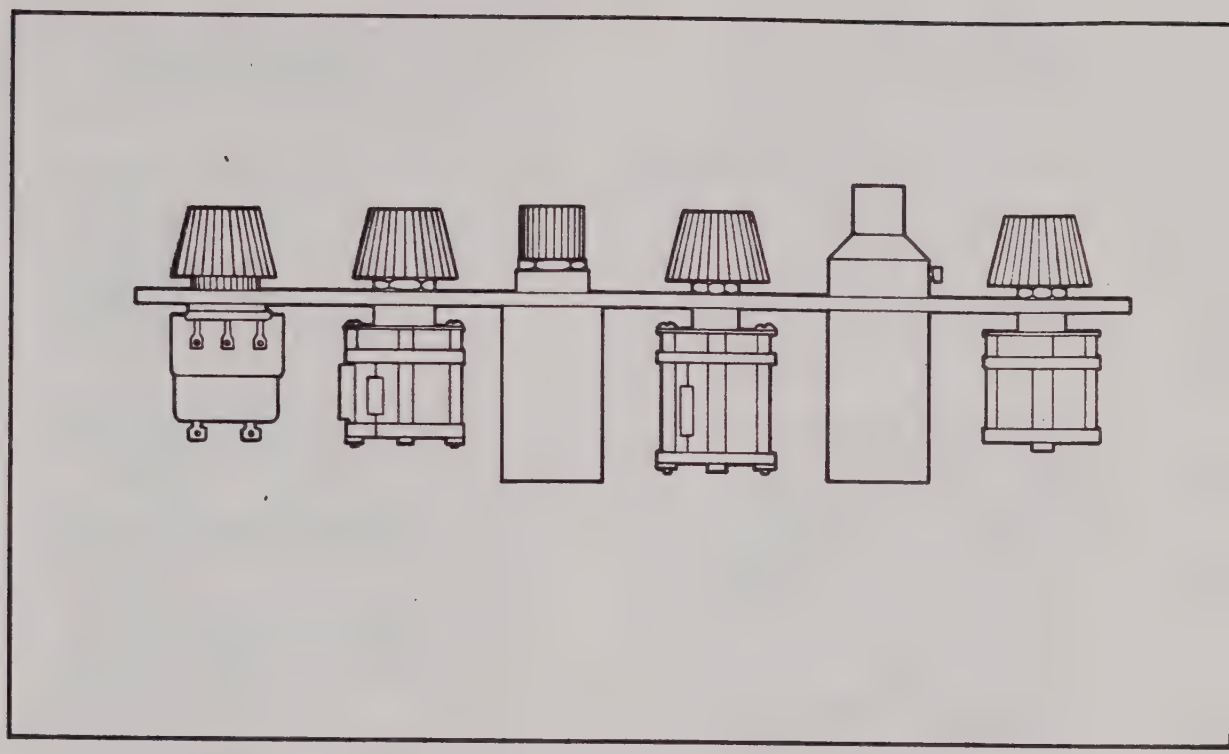


Figure 5-13. Location of Controls Below Pushbutton Switch Assembly.

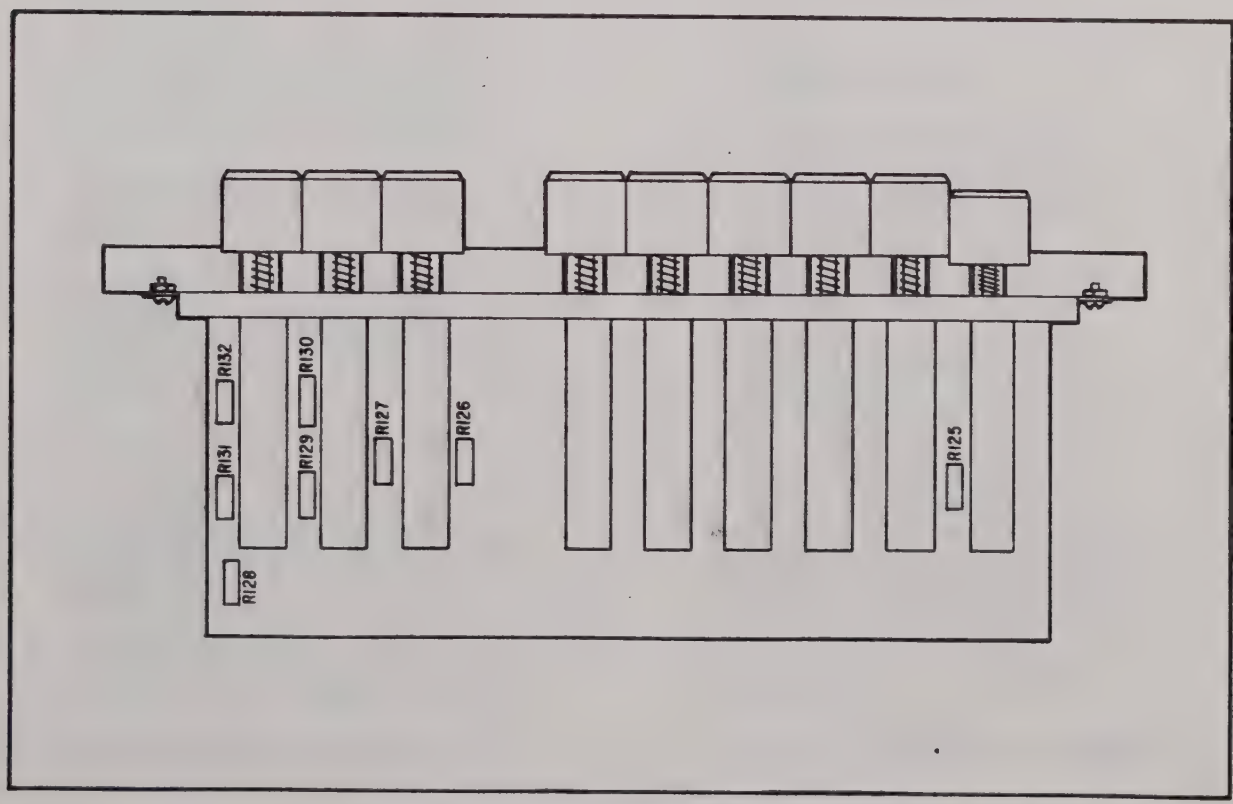


Figure 5-14. Pushbutton Switch Assembly.

any reason, calibration should be checked and, if necessary, adjusted as described below. During calibration, refer to Figures 5-4 through 5-8 for component, test point and internal control location data.

5-65. Calibration Procedure.

a. Remove the front panel and chassis assembly from the case assembly and prepare the instrument for bench operation using the AC power supply as described in paragraphs 5-7 and 5-8. Plug in the power cord.

b. Connect the Indicator to a Model 625 Calibrator 350Ω terminals (using very short leads) BK to P1, GRN to P2, RED to S1, WH to S2.

c. Set the Indicator pushbuttons for 350Ω FULL BRIDGE and X1 range operation.

d. Set the COARSE GAGE FACTOR switch to 2 and the FINE GAGE FACTOR control fully counterclockwise.

e. Set the COARSE BRIDGE BALANCE switch to 0 and the FINE BRIDGE BALANCE control to 500.

f. Set the Calibrator to OmV/V. Insert a plug into the Indicator's DYN OUT jack. (See paragraph 2-66 for plug specifications). Set the Indicator's ANALOG OUTPUT switch to 50KHz.

g. Turn the DISPLAY TIME control clockwise until the POWER indicator lights.

h. Connect the DVM across the output terminals of the plug inserted into the DYN OUT jack and adjust R119 (dynamic zero adjust control) until the output is less than ±0.10V.

i. Disconnect the DVM and remove the plug from the DYN OUT jack.

j. On the A/D Converter PC board, connect a jumper lead between TP4 and the GND test point. Then connect a DVM between TP3 and the GND test point.

k. On the A/D Converter PC board, adjust R21 (reference amplifier zero adjust control) for a reading of 0±1mV.

l. Disconnect the DVM. Remove the jumper lead between TP4 and the GND test point. Connect a jumper lead between TP10 (on the main board) and the GND test point.

m. Set the Indicator DISPLAY switch to ON.

n. Observe and record the readout on the Indicator digital display

o. Change the Calibrator setting to 5mV/V. Then again observe and record the Indicator digital display readout.

p. Using the readings recorded in steps n and o, compute the span as follows: If the signs of the two readings are the same, subtract the smaller from the larger. If the signs of the two readings are different, add the smaller to the larger.

q. Record the first span number.

r. Reverse the leads connected to the S1 and S2 Terminals of the Indicator.

s. Return the Calibrator setting to 0mV/V.

t. Repeat steps n through p. Record the second span number.

u. Adjust R19 on the A/D Converter PC board to increase or decrease the display as necessary to make the second span number equal the first span number.

v. Connect a jumper lead between TP12 and GND.

w. Adjust R10 (integrator zero adjust) on the A/D Converter PC board until the display reads 0000 ± 0001.

x. Remove the jumper lead between TP10 and the GND test point. Disconnect the Calibrator from the Indicator. Simulate a half-bridge configuration input to the Indicator by following the connection setup shown in Figure 2-6 and substituting 350Ω resistors for the strain gages.

y. Depress the 1/4-1/2 pushbutton switch.

z. Adjust the COARSE and FINE BRIDGE

BALANCE controls to obtain a zero readout on the digital display.

aa. Jumper the S1 and S2 Terminals on the Indicator with a short lead.

ab. With the X1 pushbutton depressed, adjust R94 (auto zero offset adjust control) for a digital display readout of 0000 ± 0001.

ac. Remove the jumper lead from S1 and S2. If necessary, readjust the FINE BRIDGE BALANCE control to re-zero the display.

ad. Depress the X10 pushbutton and check the digital display readout. It should not be more than ±2 counts off zero.

ae. Remove the simulated half bridge connections and reconnect the Calibrator to the Indicator as described in step b. Depress the GF ADJ and 350Ω FULL BRIDGE pushbuttons. Adjust the COARSE and FINE GAGE FACTOR controls for a gage factor digital display of 2.000.

af. Depress the X1 pushbutton switch. Set the Calibrator to 0mV/V. Then adjust the FINE BRIDGE BALANCE control to re-zero the Indicator readout.

ag. Set the Calibrator to 4mV/V. Then adjust R87 (X1 gain adjust control) for a digital display readout of 8000 ± 0002.

ah. Depress the GF ADJ control and, if necessary, adjust the GAGE FACTOR controls for a readout of 2.000. Depress the X10 pushbutton, return the Calibrator setting to 0mV/V, then check for a zero display and adjust the FINE BRIDGE BALANCE control if necessary to achieve it.

ai. Return the Calibrator setting to 4mV/V and depress the X10 pushbutton. Adjust R88 (X10 gain adjust control) for a reading of 0800 ± 0001.

aj. Reverse the leads connected to terminals S1 and S2.

ak. Repeat steps ag through ai adjusting R87 and R88 if the opposite polarity displays do not meet the indicated tolerances.

al. Again reverse the leads at Terminals S1 and S2. Then again repeat steps ag through ai. This time, however, adjust R19 (positive reference adjust control) if it is necessary to bring the readout within the indicated tolerance.

am. Depress the GF ADJ pushbutton and, if necessary, adjust the GAGE FACTOR controls for a readout of 2.000.

an. Depress the X1 pushbutton switch. Altering the Calibrator settings from 0mV/V to 9mV/V in 1mV/V steps, check the Indicator linearity as described in Figure 2-11.

ao. Return the Calibrator setting to 0mV/V. Set the ANALOG OUTPUT switch to 5Hz.

ap. Re-insert the plug into the DYN OUT jack and connect the DVM across the plug output terminals.

aq. Adjust R5 (reference amplifier zero adjust control) for a DVM reading of 0.00 ± 0.10V.

ar. To check and adjust a battery power supply, proceed as follows:

NOTE 1

To check a power supply, it should be connected to the instrument main chassis through a service extender board (BLH #417298-2).

NOTE 2

To minimize power drain while operating with a battery power supply, set the DISPLAY TIME control for a setting which can provide a convenient display time; set the DISPLAY switch to ON, and momentarily flip the READ switch to the MOM position every time a reading is required on the Indicator digital display.

1) Remove power. Remove the ac power supply. Install the battery pack power supply using a service extender board.

2) Set the DISPLAY TIME switch to ON and then advance the control approximately 1/2 turn for a convenient display time setting.

3) Connect the DVM between the -5 volt and ground test points (see Figure 5-7).

4) Depress the BATTERY CK-1 pushbutton.

5) Set the READ switch to MOM, then compare the readouts of the DVM and the Indicator digital display. If necessary, adjust R7 on the power supply board to coincide (within ±50mV).

6) Depress the BATTERY CK-2 switch and set the READ switch to MOM. The reading should exceed 4100.

as. Remove power and reassemble the instrument.

5-66. Calibration with Model 1225 Switching and Balancing Unit.

5-67. When the Indicator is used with the Model 1225, calibration of the Indicator must be performed through the Model 1225. Connect the Model 625 Calibrator to any channel of the Model 1225 as a four-arm bridge connection as shown in Figure 2-6 of the Model 1225 manual. Connect the Model 1225 to the Indicator as shown in the same illustration.

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION.

6-2. This section contains information for identifying and ordering replacement parts. The overall schematic diagram of the instrument and parts locator (reverse side) is included at the rear of this manual. Table 6-1 lists in alphanumeric order by reference designator and provides the following information on each part;

a. BLH part number.

b. Total quantity used in the instrument (TQ) column). Quantity listed where item first appears on list.

c. Recommended spares for year application in a remote location (or 2000 hours). RS column.

6-3 ORDERING INFORMATION.

6-4. To obtain replacement parts, address order or inquiry for parts to the nearest BLH Sales/Service Office (see list at rear of this manual) or direct to BLH. Identify parts by BLH part number.

To order

6-5. To order parts not listed on this section provide the following:

a. Model number of instrument.

b. Serial number of the unit.

c. Description of the part including function and location.

DESIGNATORS

A	= assembly	F	= fuse	P	= plug	TC	= thermocouple
B	= motor	FL	= filter	Q	= transistor	V	= vacuum tube, neon bulb, photocell etc.
BT	= battery	HR	= heater	QCR	= transistor-diode	W	= cable
C	= capacitor	J	= jack	R	= resistor	X	= socket
CR	= diode	K	= relay	RT	= thermistor	XDS	= lampholder
DL	= delay line	L	= inductor	S	= switch	XF	= fuseholder
DS	= lamp	M	= meter	T	= transformer	Z	= network
E	= misc electronic part	MP	= mechanical part	TB	= terminal board		

ABBREVIATIONS

A	= ampere (s)	H	= henry (hes)	nA	= nanoampere (s) = 10^{-9}	Se	= selenium
Ag	= silver	Hg	= mercury	NC	= normally closed	sect	= section (s)
Al	= aluminum	Hz	= cycles per second	Ne	= neon	Si	= silicon
Au	= gold			NO	= normally open	sl	= slide
		ID	= inside diameter	NPO	= negative positive zero (zero temperature coefficient)	SPDT	= single-pole double-throw
C	= capacitor	impg	= impregnated			SPST	= single-pole single-throw
cer	= ceramic	incd	= incandescent	ns	= nanosecond (s) = 10^{-9}		
coef	= coefficient	ins	= insulation (ed)			Ta	= tantalum
com	= common			Ω	= ohm (s)	tog	= toggle
comp	= composition	KΩ	= kilohm (s) = 10^{+3}	OD	= outside diameter	tol	= tolerance
conn	= connection	kg	= kilogram			trim	= trimmer
		KHz	= kilocycle (s) = 10^{+3}	p	= peak	TSTR	= transistor
dep	= deposited			pc	= printed circuit		
DPDT	= double-pole double-throw	L	= indicator	pF	= picofarad (s) = 10^{-12}	V	= volt (s)
		lin	= linear taper	piv	= peak inverse voltage	vacw	= alternating current working volt (s)
DPST	= double-pole single-throw	log	= logarithmetic taper	p/o	= part of	var	= variable
				pos	= position (s)	vdcw	= direct current working volt (s)
elect	= electrolytic	m	= milli = 10^{-3}	poly	= polystyrene		
encap	= encapsulated	mA	= milliampere (s) = 10^{-3}	pot	= potentiometer	W	= watt (s)
		mH	= millihenry (s) = 10^{-3}	p-p	= peak-to-peak	w/	= with
F	= farad (s)	MHz	= megacycle (s) = 10^{+6}	prec	= precision (temperature coefficient, long term stability, and/or tolerance.)	w/o	= without
FET	= field effect transistor	MΩ	= megohm (s) = 10^{+6}			ww	= wirewound
fxd	= fixed	met flm	= metal film				
		mfr	= manufacturer	R	= resistor	*	= optimum value selected at factory, average value shown (part may be omitted)
GaAs	= gallium arsenide	mtg	= mounting	rms	= root-mean-square		
GHz	= gigacycle (s) = 10^{+9}	μ	= micro = 10^{-6}	rot	= rotary		
gd	= guard	my	= Mylar®				
Ge	= germanium						
grd	= ground (ed)						

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SECTION VII
OPTIONAL EQUIPMENT INFORMATION

This section contains circuit descriptions and operating and service information for the optional plug-in devices available for use with the Model 1200B Portable Digital Strain Indicator.

PEAK & HOLD OPTION

1. GENERAL

2. The Peak and Hold Circuit is used to monitor, hold and display the highest point reached on a varying input signal. Typical applications include the monitoring of instantaneous shock loads, measurement of starting torque, drop tests, power surge levels, and destruct testing.

3. Specifications for the Peak and Hold Circuit are:

APERTURE TIME: Analog aperture time is 100 milliseconds. (Aperture time may be reduced on special order.)

HOLD TIME: 5 minutes to 0.1% or 1mv/minute.

4. The front panel of an Indicator equipped with the Peak and Hold Option is modified by replacing the READ switch with a NORM/PEAK/RESET switch. This three-position switch is used to select the desired operating mode: NORM for normal Indicator operation; PEAK for operation of the Peak and Hold Circuit; and RESET (a spring return position) which is used to unlock and reset the peak display.

5. PRINCIPLES OF OPERATION

6. The Peak and Hold Circuit is a form of sample/hold device in which the peak value of an input signal, once reached, is automatically held. A typical example is illustrated in Figure 1. For illustration purposes, the simplest sample/hold circuit is the switch and capacitor shown in Figure 2. Aperture time is the delay (reaction time) between the time the logic control signals the circuit to open and the time this actually happens. Figure 3 shows the holding error caused by aperture time.

7. The simplest peak detector circuit is the diode and capacitor shown in Figure 4. When S1 is closed and S2 is open, diode D1 allows current to flow in one direction, charging C1. When e_i becomes less than e_o, D1 becomes reversed and C1 holds its peak value. The circuit is reset when S1 is opened and S2 is closed. In the hold mode, both S1 and S2 are opened so that C1 holds the desired peak value while ignoring other larger-value inputs.

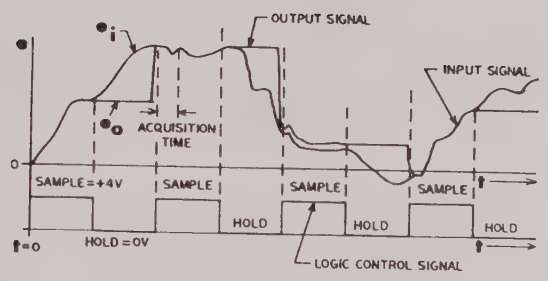


Figure 1. Input and Output Waveforms of a Typical Sample/Hold Module Circuit

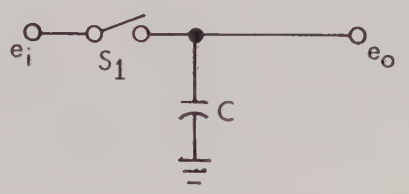


Figure 2. Basic Sample/Hold Circuit

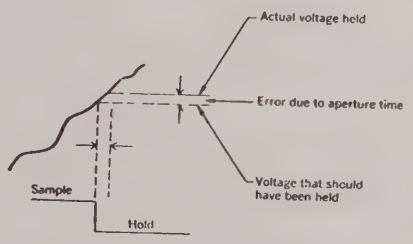


Figure 3. Aperture Time Error

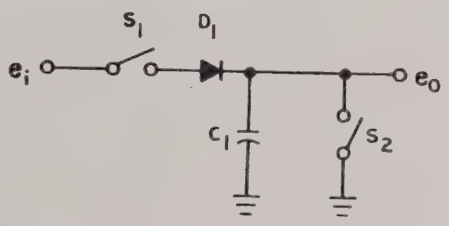


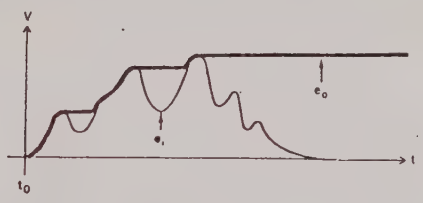
Figure 4. Basic Peak Detector Circuit

8. A schematic diagram of the Peak and Hold Circuit is provided in Figure 5. This circuit is located in the Indicator's main printed circuit board. The Peak and Hold Circuit operates on the signals supplied by the output of the preamplifier's active filter circuit. It is composed of three operational amplifiers (IC's 2, 3 and 4). Signals passing through the amplifier train are stored in capacitor C5. On ascending or descending signals, depending on the position of the "peak" jumpers, C5 contains the same voltage level as that appearing at the output of the third operational amplifier, IC4.

NOTE

For the purpose of this discussion, assume that the "peak" jumpers are set for positive-going peak signal, i.e. connected to CR3 and CR2 as shown in Figure 5.

9. Whenever signal voltage drops below the highest point reached during test or loading, the voltage stored in C5 becomes the signal and the Indicator display holds at the highest reading. If subsequent signals rise above the high point, the Indicator will unlock and track the signal until the signal decreases, at which time the Indicator will again lock on the high point as shown in the following illustration.



10. The dual FET, Q3, is equivalent to an emitter follower, but with a much higher impedance. Q3 is used to prevent C5 from leaking. Diodes CR2 and CR2A are used to prevent a polarity reversal of the voltage applied to C5. Diodes CR3 and CR3A determine the direction in which C5 will charge. The "peak" jumpers are connected to diodes CR2A and CR3A when peaking of negative-going signals is desired.

11. When the operator momentarily sets the front panel NORM/PEAK/RESET switch to RESET, +5Vdc is applied to the base of transistor Q4 which conducts energizing relay K1. The relay K1 contacts close, discharging C5 to ground and the Indicator display resets to zero. When the NORM/PEAK/RESET switch is released from the spring-loaded RESET position, it returns to

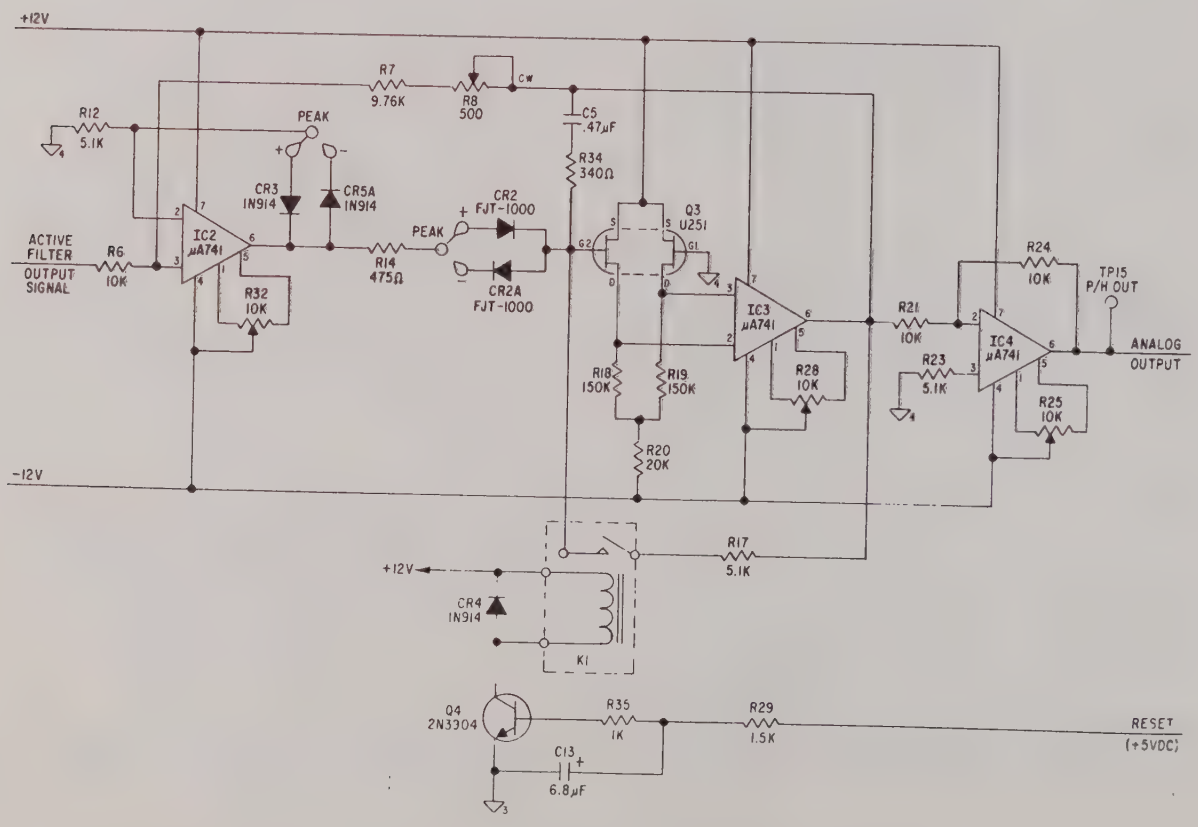


Figure 5. Peak and Hold Circuit, Schematic Diagram

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